COMPARATIVE RATING OF ELECTROMYOGRAPHS USED IN CLINIC BY MEANS OF EXPERT EVALUATIONS METHOD

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Abstract. Electromyographic examination makes it possible to determine the lesion of muscle tissue, the prevalence, severity and nature of the pathological process, therefore, great importance is given to the choice of a high-quality apparatus used in clinical practice. In order to determine the optimal device for electromyography in clinical practice, a questionnaire of 50 questions was compiled to determine the most important parameters of the electromyograph. To confirm the differentiating ability of the questionnaire developed by us, a commission was recruited. In order to confirm the differentiating ability of the questionnaire, a commission was recruited. The expert commission consisted of: 10 specialists from among the teaching staff of the Department of Orthopedic Dentistry with a course in clinical dentistry and 10 other specialists this field from among the teaching staff of the department of Normal Physiology. By the method of expert assessments, the most significant parameters for doctors were selected and their weight was determined. The most significant parameters were: «informative value» and «accuracy», which gained 0.24 and 0.23 points, respectively. An expert assessment of popular electromyographs was carried out: adaptive electromyograph "Synapsis" (NMF "Neurotech" LLC, Russia), electroneuromyograph «Neuro-MVP-8» («Neurosoft», Russia), electroneuromyograph "Neuro-MVP-Micro" ("Neurosoft", Russia). The sum of the points of all experts was multiplied by the weight of a certain parameter and entered into tables. After the calculation, the optimal electromyograph was determined. According to the results of the expert analysis of the devices, the highest points were scored by the electromyograph "Synapsis" (Neurotech, Russia): 85.85 points. We believe that in order to obtain the most accurate results in the clinic, this electromyograph can be recommended for medical use as having all important characteristics as being highly reliable.

Key words: electromyography; expert assessment; diagnostics; bioelectric activity of muscles.

СРАВНИТЕЛЬНАЯ ОЦЕНКА ЭЛЕКТРОМИОГРАФОВ, ПРИМЕНЯЕМЫХ В КЛИНИКЕ, МЕТОДОМ ЭКСПЕРТНЫХ ОЦЕНОК

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Резюме. Электромиографическое исследование позволяет определить очаг поражения мышечной ткани, распространенность, тяжесть и характер патологического процесса, поэтому выбору качественного аппарата, применяемого в клинической практике, уделяется большое значение. С целью определения оптимального аппарата для проведения электромиографии в клинической практике был составлен опросник из 50 вопросов

для определения наиболее важных параметров электромиографа. Для подтверждения дифференцирующей способности разработанного нами опросника была набрана комиссия. В состав экспертной комиссии вошли: 10 специалистов из числа профессорско-преподавательского состава кафедры ортопедической стоматологии с курсом клинической стоматологии и 10 специалистов из числа профессорско-преподавательского состава кафедры нормальной физиологии. Методом экспертных оценок были отобраны наиболее значимые для врачей параметры и определен их вес. Наиболее весомыми параметрами оказались «информативность» и «точность», набрав 0,24 и 0,23 балла соответственно. Далее проводили экспертную оценку популярных электромиографов: адаптивного электромиографа «Синапсис» (ООО НМФ «Нейротех», Россия), электронейромиографа «Нейро-МВП-8» («Нейрософт», Россия), электронейромиографа «Нейро-МВП-Микро» («Нейрософт», Россия). Сумму баллов всех экспертов умножали на вес определенного параметра и заносили в таблицы. После вычисления был определен оптимальный, по мнению экспертов, электромиограф. По результатам экспертного анализа аппаратов наибольшее количество баллов набрал электромиограф «Синапсис» («Нейротех», Россия) — 85,85 балла. Считаем, что для получения наиболее точного результата в клинике мы можем рекомендовать использовать данный электромиограф, так как он обладает необходимыми для качественной диагностики характеристиками.

Ключевые слова: электромиография; экспертная оценка; диагностика; биоэлектрическая активность мышц.

In the clinic, various apparatuses and devices are used to diagnose diseases, detect various pathological conditions and functional disorders. For example, to diagnose the functional state of skeletal muscles and peripheral nerve endings, electromyography data are used to assess the degree of bioelectric activity [2, 5].

Electromyographic study allows to determine the focus of muscle tissue lesions, prevalence, severity and nature of the pathological process. The speed, correctness of diagnosis and subsequent treatment, and sometimes even the life of the patient depends on timely diagnosis. And that is why the choice of diagnostic apparatuses and devices used in clinical practice is of great importance [7, 8]. We have analyzed the domestic and foreign sources available to us and found no studies on the evaluation of devices and apparatuses for electromyography. Both domestic and foreign authors give a description of electromyography data for assessing the state of muscles, but we did not find information on why this or that diagnostic device was chosen and whether it has all the parameters necessary for a doctor. According to the above-mentioned, we consider it reasonable to carry out an expert evaluation of electromyographs used in clinical practice.

AIM

To make a comparative assessment of electromyographs used in the clinic by the method of expert evaluations.

MATERIALS AND METHODS

In order to determine the optimal device for electromyography in clinical practice, we developed a questionnaire consisting of 50 questions divided into blocks according to certain parameters. To confirm the differentiating ability of the questionnaire developed by us, a commission was recruited. Age of expert specialists is from 45-65 years, the average age is 51.35 years. Scientific and medical experience in the specialty is from 20 to 40 years, the average is 35.5 years. All representatives of the commission are specialists of the highest qualification category and are experts in the field of diagnostics and work with electromyographs. All study participants signed consent to participate in the study, voluntary informed consent and consent to the processing of personal data.

Further, the commission gave an expert assessment of the statements with assignment of a weight coefficient ranging from 0 to 5 [1, 3, 4, 6]. The following evaluation criteria were selected: 1 — informativeness; 2 — accuracy; 3 — convenience; 4 — efficiency; 5 — portability; 6 — autonomy; 7 — cost; 8 — interface convenience; 9 — reliability; 10 — maintainability. Then we collected the opinions of experts by questionnaire survey. Experts assessed the degree of significance of the parameters by assigning them a rank number. The factor to which the expert gave the highest score was assigned rank 1. Then we performed calculations using standard formulas for calculating Pearson's concordance coefficient, summarized the obtained estimates to determine the consistency of experts and recorded them into tables [1, 3].

RESULTS AND DISCUSSION

The experts evaluated the statements proposed to them, and if the expert recognized several factors as equivalent, they were assigned the same rank number. On the basis of the questionnaire survey data, we compiled a summary

ranking matrix, and then we re-formed the associated ranks. If the sum of the matrix columns was equal to each other and to the control sum, the matrix was made correctly. The distribution of factors is presented in Table 1.

Next, we carried out the determination of the consistency of experts' opinions. For this purpose, we used the concordance coefficient, since the tables have related ranks (the same values of ranks in the assessments of one expert): S=25231.5, n=10, m=20. To estimate the average degree of consistency of opinions of all experts, we used Pearson's concordance coefficient W according to the standard formula. Since χ^2 calculated (151.04) ≥ to tabular (16.91898), W=0.84 indicates that this value is not random. Based on obtaining the sum of ranks, we calculated the weighting indices of the considered parameters. We transformed the survey matrix into a matrix of transformed ranks by the formula $s_{ij} = x_{max} — x_{ij}$, where $x_{max} = 5$. And then on the basis of the sum of the ranks of experts' opinions we calculated the value of the weighting of indicators [1, 3, 6] and recorded it in Table 2.

The opinions of 10 experts from the faculty of the Department of Orthopedic Dentistry with a course of clinical dentistry and 10 experts from the faculty of the Department of Normal Physiology were maximally coordinated. And af-

ter calculating the results, the most weighty parameters, judging by the number of points, were "informativeness" and "accuracy" for the experts, gaining 0.24 and 0.23 points, respectively. According to the experts, these are the parameters that an optimal electromyograph should possess. The least significant (weighty) parameters, with 0 points, were "interface convenience" and "maintainability".

Next, the experts evaluated the electromyographs offered to them: the adaptive electromyograph Synapsis ("Neurotech", Russia), the electroneuromyograph Neuro-MVP-8 ("Neurosoft", Russia), and the electroneuromyograph Neuro-MVP-Micro ("Neurosoft", Russia). The sum of scores of all experts was multiplied by the weight of a certain parameter and entered into tables. Here the experts' opinions were divided: specialists of the Department of Orthopedic Dentistry with a course of clinical dentistry gave more points to electromyograph "Synapsis" ("Neurotech", Russia), and their average score on the parameters amounted to 4.85 points for all parameters, while the expert specialists of the Department of Normal Physiology evaluated this electromyograph by 4.5 points. Electroneuromyograph "Neuro-MVP-Micro" ("Neurosoft", Russia) was given more points by the specialists of the Department of Normal Physiology, and their average score amounted to

Table 1

Distribution of evaluation criteria by importance for experts depending on the number of points scored

Factors	x_1 informativeness	x_2 precision	x_4 efficiency	x_7 cost	x_9 reliability	x_5 portability	x_6 autonomy	x_3 convenience	x_8 user-friendly interface	x_{10} maintainability
Sum of ranks	38	41,5	67	68,5	106,5	128,5	149,5	156	171	173,5

Table 2

Weighting of statements according to experts

Factors	x_1 informativeness	x_2 precision	x_3 conconvenience	x_4 efficiency	x_5 portability	x_6 autonomy	x_7 cost	x_8 user-friendly interface	x_9 reliability	x_{10} maintainability	Total
Sum of experts' scores	63	61	6	45	15	8	44	1	24	0	267
Weight, λ	0,24	0,23	0,02	0,17	0,06	0,03	0,16	0	0,09	0	1

4.79 points for all parameters, while the expert specialists of the Department of Orthopedic Dentistry with a course of clinical dentistry gave this electroneuromyograph only 4.47 points. As for the electroneuromyograph "Neuro-MVP-8" ("Neurosoft", Russia), the opinion of most of the experts was similar, and it scored an average of 3.7 points for all parameters.

We believe that this distribution of votes of expert specialists is justified by different approaches to diagnosis. Informativeness and accuracy are important to dentists, followed by convenience, cost and maintainability. These characteristics correspond to the electromyograph "Synapsis" ("Neurotech", Russia), which is popular in the clinic of dentistry, and provides an opportunity to obtain accurate information on four channels of signal perception.

It is important for physiologists to have all the necessary functions in a small-sized device, as well as informativeness and accuracy of diagnostics. All these parameters are presented in the electroneuromyograph Neuro-MVP-Micro ("Neurosoft", Russia). This device has a small size, provides sufficient diagnostic accuracy, transmits the signal through two channels of perception. It is enough for diagnostics of the majority of skeletal muscles, for conducting researches in the clinic, but it is not enough for analyzing the biopotential of masticatory muscles. Apparently, this is why dentists put this device on the second place.

Regarding the electroneuromyograph "Neuro-MVP-8" ("Neurosoft", Russia), we believe that it was evaluated in a similar way due to its insufficient accuracy, low informativeness and cumbersomeness.

Further, taking into account the weight of the most significant parameters for experts and the expression of these parameters in the devices presented for evaluation, the optimal apparatus was determined by carrying out calculations using the method of expert evaluations. 20 expert specialists answered 50 questions of the questionnaire, rated three devices in the range from 0 to 5, then the obtained results were multiplied by the weight of the statement and recorded in tables. Then we made calculations and it turned out that the experts evaluated the electromyograph Synapsis ("Neurotech", Russia) at 85.85 points, the electroneuromyograph Neuro-MVP-Micro ("Neurosoft", Russia) scored, according to the experts, 84.35 points, and the electroneuromyograph Neuro-MVP-8 ("Neurosoft", Russia) scored only 77.2 points.

Such estimates correspond to the actual state of affairs, as the most popular electromyograph in Russia is the electromyograph "Synapsis" ("Neurotech", Russia). It is the most popular because of its diagnostic accuracy, informativeness, convenience and successful advertising strategy.

To test this hypothesis and exclude unreasonable assumptions, we used the method of expert evaluations, as it allows us to translate subjective opinion into the language of numbers and give an objective, accurate assessment of various statements. In our case, the experts' opinion coincided with our assumptions about the most optimal device.

CONCLUSION

According to the results of the expert analysis of the devices, the electromyograph Synapsis ("Neurotech", Russia) received the highest scores with 85.85 points and took the first place among the proposed devices for electromyography. We believe that to obtain the most accurate result in the clinic we can recommend using electromyograph "Synapsis" ("Neurotech", Russia), as it has important characteristics for a doctor, namely, high diagnostic accuracy, informativeness, efficiency in operation and relatively low cost.

ADDITIONAL INFORMATION

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