School Screening for Bad Posture with Spine Mouse Device

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Abstract

Background. The spine deformities are presented with 27.3% in the population regarding all deformities of the muscle system. The clinical examination has its limitations as a result of the subjective participation of the examiner and the lack of qualitative measurement.

Aim. In our research we tested the applicability of the software program Spine Mouse in screening of the spine deformities. The software program is important for spine examination in the sagittal plane.

Material and Methods. In order to evaluate the software in the screening program for bad posture, we made a score with maximum points and possible gained points regarding the parameters: number of children who participated in the examination out of the entire population, number of the examined, preserved data from the examination and cooperation during the examination.

Results. A total of 986 children were examined for 15 days with 6 children examined per hour or 74%. Of the total number of children, 97.2% cooperated during the examination and the data were lost for 14.7%.

Conclusion. The results showed that this software is applicable with significance for examination of spine deformities in the school population. The cost of the software and the speed of the examination are limiting factors for its use in a large population.

Introduction

Spine deformity is found in 27.3% of the population regarding all deformities of the muscle bone system. Scoliosis is presented with 1.5%-4%-6.3% [1-3] of the total number of spine deformities. The remaining percentage belongs to deformities of sagittal plane, which is not a small percentage if it is known that 10% of untreated bad postures lead to structural scoliosis [4]. The postural deformities can be prevented and treated while the structural ones can only be treated. If not treated, both the functional and the structural spine deformities lead to functional disorders of the respiratory and cardiovascular systems, esthetic defects and pain, which, in turn, reduce the physical condition and working capability of the individual [5-7]. Consequently, medical science has attributed large importance to the spine deformities many centuries ago and ways for their early detection have been retrieved. In the process of early detection questionnaires and clinical monitoring have been included [8, 9]). The clinical examination has several limitations, such as the subjective participation of the examiner and the lack of qualitative measurement and evaluation of in a given period. There have been attempts for founding new technical possibilities of the curve measurement [10].
In addition to the already existing percutaneous methods, the importance of the radiographic image is huge and for now it can be used for determination only of the size of the curves in frontal and sagittal plane, but, on the other hand, it is with a great dose of radiation and it cannot be repeated earlier than 6-12 months. There have been continuous efforts and constant development of the technical possibilities for percutaneous diagnostic procedures and observation of the conditions over the last several decades [11]. Ten years ago a software program Spine mouse was applied for the first time [12,13].

The aim of this paper was to determine the application rate of the Spine mouse software program in the early detection of bad posture in school population as an important health activity, as well as to define the cost of this examination per a child and the efficacy of the examination.

Material and Methods

The research was conducted in an elementary school in Bitola after obtaining permission for it by the Ministry of Education, the municipality and the children and parental consent according to the ethical and legal regulations. The parents were informed about the objectives of the research team and of the project activity by distributing an educational leaflet in the chosen school.

A total of 1109 children at the age of 6-15 in nine school grades were included. The examination consisted of:

1. Questionnaire with personal data of the child, his/her age, attending grade, which was completed by the parent together with the signed permission for participation in the examination.

2. Clinical test by Mathias characteristic for the bad posture in sagittal plane. The test is performed in a standing position with antiflection of the hands for 90 degrees. The spine is analyzed in a profile and it is monitored whether the four leading points are different from the straight line set vertically on the base. The leading points for monitoring are: the middle of the ear, the middle of the shoulder, the middle of the pelvis, and the middle of the foot.

3. Examination with the percutaneous software program Spine mouse is significant for determination of the differences from the normal curves in sagittal plane and the appearance of weakness of the back muscles [14, 15]. The software is standardized to present the differences from the physiological values of the curves according to sex and age. The software is characterized with absence of X-ray, small dimension, ergonomic design and compatible Microsoft Office for the execution of the recording. The child is put in the position of the test by Mathias and he/she is recorded immediately; he/she remains in the same position for 60 seconds; then the recording is repeated. When there is weakness of the back muscles, the curves in the sagittal plane are emphasized and the software detects them.

4. In order to evaluate the applicability of the software in the school screening examination, we made a score with the following parameters:

   4.1. How many children came for examination out of the total number of children in the school?
   4.2. How many children showed cooperation during the examination out of the total number of examined children?
   4.3. How many children complained on pain during the examination?
   4.4. How many data have been lost from the examination because of the delay of the software?

5. As a measure for the efficiency of the examination served the number of children examined for 1 hour and for the cost of the examination itself we compared the number of examined children and the cost spent for the examination. Expenses have to be planned for the following items in the examination:

   Education of the staff, photocopies of the examination protocols, telephone conversations, transportation, software program, and money spent for buying one personal computer.

Analysis of the statistical data was done with the statistical program STATISTICA 6 and Microsoft Office Excel 7. The nominal analysis was done with mean value, standard deviation and percentage presence. For descriptive analyses of the presence of the frequencies per examination and score, Chi-square test and Student’s t- test for significance of p<0.05 were used.

Results

The presented results are extracted from the data of completed questionnaires, clinical examination, examination with the software, evaluation of the applicability of
the software by scores and expenses spent per child.

Results from the questionnaires

Of the total number of children in the school (1109), 984 (88.7%) were included after getting their parents’ approval for participation in the examination; 49% were female and 51% male. The distribution of children by gender and age tested with the Chi-square test was not significant, and a homogeneous group could have been analyzed by gender $\chi^2=12.54$, p>0.05 (Table 1).

Table 1: Distribution of school children by sex and classes.

<table>
<thead>
<tr>
<th>Classes</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>93</td>
<td>51</td>
<td>42</td>
</tr>
<tr>
<td>2</td>
<td>60</td>
<td>31</td>
<td>29</td>
</tr>
<tr>
<td>3</td>
<td>88</td>
<td>39</td>
<td>49</td>
</tr>
<tr>
<td>4</td>
<td>94</td>
<td>44</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>82</td>
<td>46</td>
<td>36</td>
</tr>
<tr>
<td>6</td>
<td>92</td>
<td>41</td>
<td>51</td>
</tr>
<tr>
<td>7</td>
<td>106</td>
<td>46</td>
<td>60</td>
</tr>
<tr>
<td>8</td>
<td>100</td>
<td>51</td>
<td>49</td>
</tr>
<tr>
<td>9</td>
<td>106</td>
<td>55</td>
<td>51</td>
</tr>
</tbody>
</table>

$X \pm SD$ 91.2 $\pm$ 14.1 41.88 $\pm$ 7.27 46.33 $\pm$ 9.24

1. Of the total number (1109), 984 were examined (89%), maximum 984 points.

2. Of the total number of the examined children (984) 798 (81%) or 798 points showed good cooperation

Results from clinical examination and examination with the software

The results of the clinical examination for deformities in sagittal plane or bad posture and of the examination with the software in position of Mathias are shown in Table 2. The significance of frequency by grades has been tested with the Chi-square test. The frequency of children examined both with the clinical test and the software is significant. The clinical examination and the examination with the software are presented in Figures 1 and 2.

The frequency of distinct spine kyphosis in children was higher with the clinical examination than with the software examination.

Results for the applicability of the school screening examination with the software.

The total number of children who attended the elementary school was 1109.

Table 2: Frequentation of children with positive Mathia’s test with clinical examination and examination with software.

<table>
<thead>
<tr>
<th>Classes</th>
<th>Total</th>
<th>Positive Mathia’s test</th>
<th>Hyper Kyphosis with Spine mouse</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>93</td>
<td>66</td>
<td>21</td>
</tr>
<tr>
<td>2</td>
<td>60</td>
<td>43</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>88</td>
<td>47</td>
<td>25</td>
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<tr>
<td>4</td>
<td>94</td>
<td>51</td>
<td>28</td>
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<tr>
<td>5</td>
<td>82</td>
<td>46</td>
<td>43</td>
</tr>
<tr>
<td>6</td>
<td>92</td>
<td>66</td>
<td>18</td>
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<tr>
<td>7</td>
<td>106</td>
<td>65</td>
<td>45</td>
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<td>8</td>
<td>100</td>
<td>64</td>
<td>30</td>
</tr>
<tr>
<td>9</td>
<td>106</td>
<td>64</td>
<td>39</td>
</tr>
</tbody>
</table>

Total 821 512 264

$X \pm SD$ 91.2 $\pm$ 14.1 56.9 $\pm$ 9.8 29.3 $\pm$ 11

% 100 62 32

T-test $t = 9.6$ $t = 7.84$

$T$-test $p < 0.05$ $p < 0.05$

Figure 1: Examination with the percutaneous software program Spine mouse.
3. Of the total number of examined children (984), there were no children who had complained on pain during the examination, points 984.

4. Of the total number of examined children (984), the data were lost for 163 (15%) due to inadequate input in the program. Maximum points for this question are 821 (85%).

Regarding the questions, maximum number of points is 4061 and we got 3587 or 88%. Chi-square test showed to be significant in application of the software as a method for detection of bad posture in the school children ($\chi^2=1.09$, $p<0.05$). The results are shown in Table 3.

The efficiency was calculated by examined children per hour and got 6.

Table 3: The applicability of the school screening examination with the software.

<table>
<thead>
<tr>
<th>Variation</th>
<th>Total</th>
<th>Examination</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total interviewed</td>
<td>1109</td>
<td>984</td>
<td>89</td>
</tr>
<tr>
<td>Cooperation</td>
<td>984</td>
<td>798</td>
<td>81</td>
</tr>
<tr>
<td>No pain</td>
<td>984</td>
<td>984</td>
<td>100</td>
</tr>
<tr>
<td>Software data</td>
<td>984</td>
<td>821</td>
<td>85</td>
</tr>
<tr>
<td>Total points</td>
<td>4061</td>
<td>3587</td>
<td>88</td>
</tr>
<tr>
<td>Chi$^2$</td>
<td></td>
<td>Chi$^2=1.21$, p&lt;0.05</td>
<td></td>
</tr>
</tbody>
</table>

Discussion

There is no unified examination of spine deformities in the world regarding questionnaires [7, 8] as well as examination itself and observation of the situation. Standards have been set for the clinical examination [2, 4, 10], but they are not significant since they are not exactly measurable and are only considered as a positive or negative test. The prevalence in the population is different and there are no exact data that could help in defining the situation with this medical problem today [1].

The school screening examination is being practiced in many countries in the world for early detection and prevention of the development of one functional deformation into structural [3, 5, 6]. The quantitative measurement of the curve in its conclusion is significantly possible only with a radiographic image and the patients are disposed to X-ray [14]. There have been attempts for enhancement of the percutaneous methods for indirect determination of the size of the curves [10]. In our research we encountered children with distinct curves in the sagittal plane discovered as a positive clinical test as well as a distinct spine kyphosis found out with the software examination. Since the software is significant for examination of curves in a sagittal plane as compared to the x-ray image, the frequencies of presence from the software have to be accepted. Consequently, the frequency of children with distinct spine kyphosis and weakness of the back muscles would be 32% instead of 62% discovered with the clinical examination in our research. As reported in the literature the software program was used for the first time in 1997. Since then, the published articles have presented the significance of its application in measuring of the spine curves and its mobility both in children and in adults with different spine diseases [12-18]. Only in one article the significance of the software program was compared with the radiographic images as a measure for determination of the size of the curve in sagittal and frontal plane [19, 20]. The authors of this article have emphasized that this software is significant for curve determination in a sagittal plane and for confirmation of the scoliosis curve further investigations are necessary.

Regarding the cost of the examination of the spine...
deformities as a screening program, we found out that they have not been practiced in Great Britain because they burden the health system [20]. In the United States there are large population examinations, but these are primarily clinical examinations with tests, topographometry and questionnaires [21]. In Japan this kind of examination is regulated by law and is executed with clinical survey, questionnaire and percutaneous methods that contain a low dose X-ray radiation, but there are no unified methods [22]. In Australia the screening examination is made by the parents with instructions from leaflets distributed through the school [23]. In Macedonia general systematic examinations regulated by law are performed in elementary schools every 24 months. The general systematic examination is made by a general practitioner and a nurse and it also includes an examination of the muscular spinal system (spine, feet and chest) [24]. These examinations help to discover children having bad posture. The detection is based on a qualitative conclusion of presence or absence of positive finding without quantitative determination of the size of the curve.

The introduction of percutaneous methods and unified questionnaires might enable monitoring of the situation of the verified cases of increased chest kyphosis and lordosis as it was done in our research with or without treatment, in time intervals shorter than 12 months.

The cost of the examination (11$ per child) is approximately the same as in other researches in the world (4-24$) [9, 20, 25]. Limitation factors of this examination include: the examination of six children per hour, only one examiner can work with the software, and the price of the software.

Taking into consideration the cost of the software, many countries of the world with large populations and which belong to the underdeveloped rural areas would not be able to use it for screening examination. Thus, the possibility for unified examinations of spine deformities worldwide is being reduced. The preventive examinations can be defined worldwide if the World Health Organization sets and unifies the protocols and the standards for examination and if this Organization supervises their realization in each country. The means necessary for the examination according to the number of children at the age of 6-15 years should be given by each country separately.

Conclusions

In conclusion, it could be said that frequency of children with bad posture is significant and it has been confirmed both with the clinical examination and with the software examination.

The software program is easy for application, but its drawback is in its use by only one examiner, which results in low speed rate for examination of a large population and this is an important feature of this type of examinations.

The expenses of this kind of organized school examination of children are almost the same as those found in literature. This kind of examination can be used for research aims and for evaluation of the effect of the treatment. However, a wider screening examination might burden the health system with its price.

References

10. Vrtovec T, Pernus F, Likar B. A review of methods for quan-


