PRODUCTION OF SPINAL ORTHOSES WITH CAD/CAM AND CONVENTIONAL MEASURING METHODS

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Abstract

Our experience has shown that introducing CAD/CAM technology to spinal orthotics, due to the decreased weight of models, has facilitated the production and shortened its time compared to using plaster cast which is very time consuming since it requires waiting for the plaster to dry. The aim of the study was to compare the CAD/CAM measuring methods with standard methods in the production of spinal orthoses and to identify the advantages and disadvantages of both. The study included all the persons whose measurements for spinal orthoses were taken at the Institute for Rehabilitation, Republic of Slovenia, in the period between November 1, 2007 and February 29, 2008. When the measuring was performed by scanning the body or the negative, the model (the positive) was 10 to 20 times lighter than when using the classical method of measuring. In scanning, the time of the measuring was shorter by half an hour and working on the model by an hour and a half. The production of spinal orthoses with CAD/CAM measuring is simpler for both, the subject and the engineer. The scanning based models are lighter and can be managed by female engineers as well.

INTRODUCTION

The introduction of computer equipment has put an emphasis on mathematical algorithms that enable an analysis of visual data. On the basis of three dimensional measurements wire models are created that can be then manipulated by CAD/CAM tools (1). There are several ways possible to go from measurement taking to model making. A frequently used method is laser scanning (2) with distance sensors based on laser technology. The Institute for Rehabilitation started introducing that technology seven years ago. CAD/CAM technology by the producer CAPOD was employed. Aportable scanner was used at first and after two years a big orthotic scanner was activated.

The Swedish CAD CAM system CAPOD consists of a stationary rotating device for scanning the entire body. By means of a device for measuring anthropometric data 3D values are taken and transferred into a computer. Adata processing program makes a 3 dimensional model that can be corrected in the software. The model can be contracted or stretched out, it can be polished, rotated or made narrower so as to suit the required dimensions. Then the model is saved in CAD form and transferred to a milling machine, where the actual physical model is made (3,4).

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METHODS

In the research process, data were collected for the subjects using spinal orthoses and a questionnaire was used on the type and the production method of the spinal orthoses. The measurements of the subjects' weight and height were taken. For each subject, a questionnaire was filled with the measured data and the measured time of production and design of the spinal orthoses. The measurements of the adult subjects to be fitted with a TLSO PE were performed by scanning, with the exception of the subjects who had problems with standing straight. For the purpose of correction and more precise data in corrective spinal orthoses, the measurements were done with plaster casting and curves were corrected by means of a special table and Glison's loop. The plaster negative was then scanned. The study included all the persons whose measurements for spinal orthoses were taken at the Institute for Rehabilitation, Republic of Slovenia, in the period between November 1, 2007 and February 29, 2008. The data were analyzed by SPSS computer software.

RESULTS

It was found that the negatives of the different types of spinal orthoses weighed differently. The average weight of the Lyon negative was 1.7kg, of Milwaukee 1.2kg and of TLSO 0.6kg.

The next finding was that the method of measuring affected the model's weight. When measuring the trunk of adult subjects by means of scanning the model weighed 4.6kg, when scanning the negative of children it weighed 2.8kg and when plaster casting either adults or children the model weighed 50kg.

Taking the measurements by means of plaster casting was problematic in all the subjects.

The age of the subjects was found to influence the type of spinal orthoses used. The children, aged 12 years on average, wore Milwaukee, 16 years old subjects wore Lyon and the adult subjects, aged 55 on average, wore PE TLSO.

The type of spinal orthoses was found to affect the measuring method. The subjects with Lyon orthoses were measured by scanning the negative, one third of the subjects with Milwaukee were measured with plaster casting. More than two thirds of adult subjects were measured by scanning, the rest were measured by plaster casting.

On average, the scanned models were worked on for one hour while the plaster cast models took two hours and a half. In measuring, the scanning method took one hour on average and plaster casting an hour and a half.

DISCUSSION

The study found differences between the use of CAD/CAM and standard measuring methods that were shown in the weight of the models, the time necessary for measurement taking and working on the models The measuring method affected the model's weight. When scanning the body or the negative, the model (the positive) was 10 to 20 times lighter than when using the standard measuring method. In scanning, the measuring time was shortened by half an hour and working on the model by an hour and a half. Other authors (5) have also reported the scanning method to have shortened measuring time by half an hour and working on the model by more than an hour compared to standard plaster casting method. Wong et al. (6) reports the time of working on the model to be shortened by an hour and a half when using the scanning method compared to the standard method. Standard measuring method can be problematic in subjects who have problems with standing or have certain diseases (such as Mb Parkinson, when the tremor prevents accurate correction).

The next finding was that the type of spinal orthoses affected the weight of the negative and the measuring method. The type of orthoses affected the weight of the negative due to the surface covered with plaster and different numbers of plaster layers. The age of the subjects was found to influence the type of orthoses worn - the children and the adolescents wore corrective orthoses for scoliosis while the adults used PE TLSO for spondylolysis or spondylosthesis. The type of spinal orthoses influenced the measuring method for the purpose of achieving more accurate correction in measurement taking.

CONCLUSION

The development of the technology has brought many advantages such as repeatability of the process, a possibility of changing or updating models without repeated scanning and finally, acomprehensive database that can be accessed remotely, including the patient's medical records.

The results can be summarized in the following: the production of spinal orthoses with CAD/ CAM measuring shortens the production time, which brings positive economical effects. The CAD/CAM measuring method is simpler for both, the subject and the engineer. The scanning based models are lighter and can be managed by female engineers as well.

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