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Conservative Treatment of Idiopathic Scoliosis with Asymmetric Dynamic Brace Crass Cheneau® and Use of 3d Surface Topography Laser Scan

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Abstract

Scoliosis is a three-dimensional spinal deformity with main characteristics in most cases the sideways curve and spinal curvature (organic form), which causes general deformation of the biomechanics of human body at the thoracic part or at the pelvis or in both areas. In the extensive relative medical bibliography, you may find significant proposals for conservative treatment with the use of braces and special physiotherapy exercises. Regardless their volume, in bibliography there is not a connective presentation and this raises the possibility of misunderstandings and in many cases even the incorrect use of them by the medical community. It is hoped that this project will contribute to the clarification of this issue and will help to the correct use.

Materials: Dynamic scoliosis brace Crass Cheneau® and Schroth exercises swimming (freestyle). Clinical evaluation every month. Evaluation of surface measurements of deformation with the use of the method of 3D laser scan of surface topography (MOIRE software and SENSE 3d laser scanner | Anatomic landmarks as suggested by SOSORT) | Mesh Lab and AUTODESK 123D software. Asomatometric radiography with the brace once. Fifty (50) patients suffering from idiopathic scoliosis 45 girls, 5 boys. Age Girls: 10 to 18 years old (Average 14.4) | Boys 14 to 18 years old (Average. 16). Cobb Corner Thoracic Average 31° (9° – 49°) Lumbar Average 34° (14° – 57°) Height: Girls 148 cm to 177 cm (Average. 162.5). Boys 155 cm to 184 cm (Average. 169.5). Weight: Girls 23 kgr to 67 kgr (Average. 45 kgr) Boys 40 kgr to 80 kgr (Average. 60 kgr).

Method: Inter and Intra observer reliability, individually in each case.

Duration: March 2012 - March 2016

Keywords: Scoliosis: Crass Cheneau; Moire fringe mapping: hand held LASER

Foreword

Αισχρόν το γ' αισχρόν, καν δοκή καν μη δοκή.

Antisthenes, 445-360 BC., Cynic philosopher

(Translation: what is ugly is ugly; whether visible or not.)

Hippocrates (460-375 BC) was the first to use the terms "scoliosis", "kyphosis", "lordosis" in order to describe spinal deformities. However, even hundreds of year later, the etiopathogenesis of deformity remains unclear. Scoliosis is rather a descriptive term and not a diagnosis.

It is a complex, multifactorial (three-dimensional) spinal and body deformity having as main characteristics the sideways bend and curvature of several vertebras but mainly the lordosis of the spine, to which special attention is paid regarding its etiopathogenetic and predictive role (P Symeonidis, 1997). It is normally asymptomatic; therefore it often escapes our attention in the early stages. In numerous related medical references one may find significant but mostly conflicting opinions and views regarding the nature of idiopathic scoliosis, its aetiology, its prediction, or treatment. An effort has been made in

order a common communication code to be created between the scientific fields working on spinal deformities by the international scientific communities SOSORT and SRS - among others - that created guidelines. In this study, it raised the need to take distance from any previous practice, theory, or study. Even from the lines that are widely accepted by the scientific community.

Our purpose was actually to achieve a conservative treatment within the strict framework of the mechanic rules of human body that would be able to significantly correct the deformity and the simplest and most effective way for its implementation for spinal deformities (idiopathic scoliosis). Starting this study from scratch, even after the first X-rays we studied of children >12 years old and regardless the size of Cobb angle, it became clear that the deformity was clearly mechanical, as an instability of the whole of the developing spinal column. No degeneration, no test or congenital deformity was found on the vertebral bodies or any other part of the human body, even at children at 4 and 5 Risser stages that could be considered completely orthopaedic disease. This was reasonable, ince it is already known!

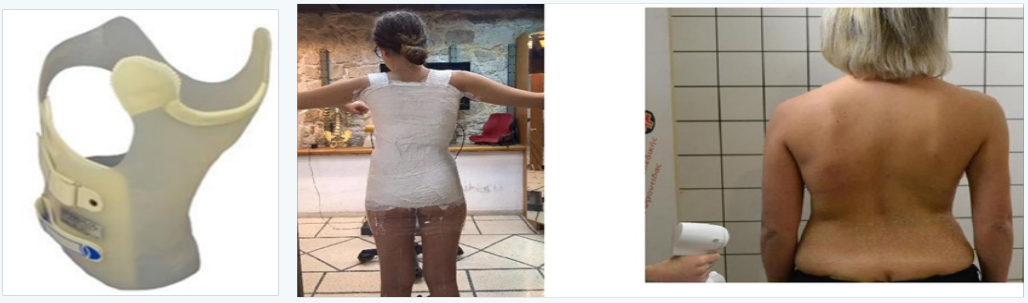
If we compare human spinal column with a train having 33 or 34 wagons and moving on parallel rails holding it on its course, if for an unknown reason, these rails cease being parallel with obvious tendency to create conditions of derailment, what is the reason investigating the train and its age, since the trails are the problem? At this point the following concern raised:

The curvature of the deformity is for instance due to the right external oblique or the left internus oblique muscle

This study did not reply the question "whose fault, is it?" but a new approach emerged and this may be the beginning of the solution. Since it became possible (with the available means) to determine with precision the "problematic muscles" and taking into consideration that even if this is possible, it would be impossible to isolate and correct them, we considered a priori "problematic" the whole component structure of the deformed spinal column. This created the need for a new dynamic brace, paying special attention to the mechanic rehabilitation of the deformity.

Introduction

The new dynamic asymmetric brace Scoliosis Treatment Crass Cheneau® (Figures 1 & 2) is made of special hypoallergenic polypropylene, 2.5 to 3 mm. of thickness, semi-transparent when applied on the patient's body. Laser scanner technique (Figure 1B) or the uses of plaster tape at lordosis position are required to estimate the size of the patient's body (Figure 1A).



1A 1B

Figure 1A: Estimation of size of the patient's body.
Figure 1B: Laser scanner technique.
Figure 1: New dynamic asymmetric brace Scoliosis Treatment Crass Cheneau®.

Figure 1C: Vertebra to the angle of O[5].

Figure 1D: Vertebra to the angle of O[5].

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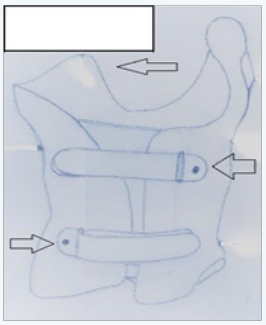

Figure 1E: Case Velcro.

Figure 1F: Vertebrae.

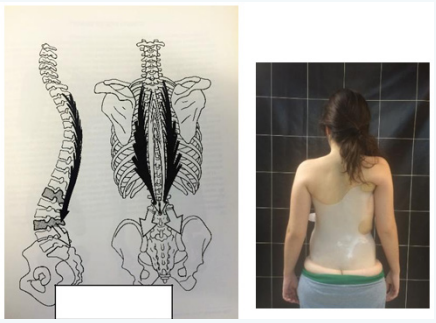

Figure 2: According to Delmas.

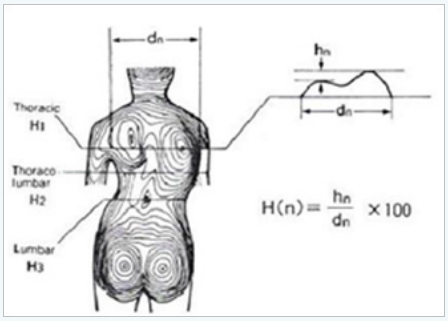

Figure 3: Hand-held LASER system with the use of MOIRE [7,8,10,12,18,20,25,29].

Especially in the cases of thoracic scoliosis the body scan is necessary to be made by hand-held LASER scanner in two positions (resting position and in right angle position 90° (Figure 3) in full dilatation of the chest - inhalation) [1-3]. Then, the scans are processed (volume measuring) and compared with the use of Mesh Lab or AUTODESK 123D (free software) for the avoidance of deformities of the thoracic part and reduction of the respiratory volume during the application and use of the brace.

After the above measurements, during the processing of the preform, the technician forms arrays and single, perimetric pressures, beginning from the edges of the iliac apophyses, with loadings and unloading of the opposite areas, having as highest point the last deformed vertebra to the angle of O^5 (Figures 1C-1E). The same procedure is also followed for curve deformity at the area of the chest and the pelvis.

Then, with the use of vacuum (negative pressure) we place the thermoplast on the preform without previous use of interior coating (to avoid air lock-in at the points of maximum pressure during the placement of the thermoplast). Regarding the mechanic principles of the brace, special attention was paid to the functional importance of some vertebras that play predominant role for the maintenance of standing position (Figure 2A) according to Delmas) [4]. O^5, the sphenoid shape of which operates as bridge between the sacral vertebra and the spinal column [4].

O^3 that is pulled backwards by the muscles beginning from the bone and the ilium and serves as origin of the pectoral muscles. Predominant role and one of the functional construction properties of dynamic brace Scoliosis Treatment Crass Cheneau® is the use of Velcro. In that case Velcro (Figure 1E) do not function simply as holders but also as pressure regulators and consequently for the correction of deformity. Therefore, the points and way of application are of crucial importance.

It should be noted that the shape of the brace (Figures 1,1D,1E) is not restrictive and its sub-differentiation depends on the height (area) of each case of deformity. Its way of construction with negative pressure, the least thickness and almost zero weight offers perfect fit on the user's body, making it bearable, invisible, effective but foremost directly corrective for all three dimensions of spinal deformation.

Its use ranges between 12 to 16 hours / day.

Its effectiveness lies to the arrays surrounding pressures to the digital preform and the cuneiform adhesions on the structure of one and only typical vertebra [4,5] at the time, with their application during the construction of the brace. The arrays surrounding pressures on a deformed spine minimize the resistance of the spine at the deformed area (hump of dynamic type) as well as axial compression forces (Delmas index), disarm the mechanism of turn - side bend at the thoracic part (which accompanies the deformation of Cobb's angle in idiopathic scoliosis), as well as the mechanical resistance, limiting the amplitude of movements of the thoracic spine, as well as of the side bend.

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Body surface topography

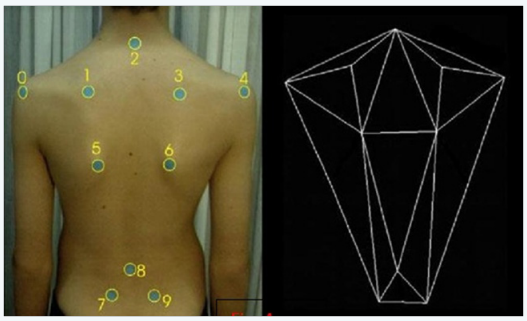

Figure 4: Body Special adhesive pants/relection.

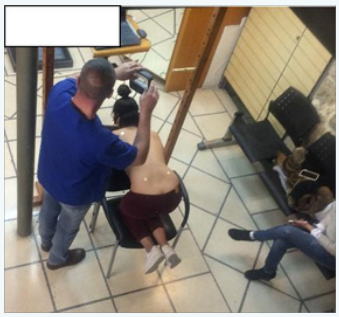

Figure 4A: Body scan of user while wearing the brace.

Hand-held LASER system with the use of MOIRE [1,5-11] (Figure 3) data analysis provided three-dimensional digitization of the surface of the patient's body. We place of the surface of the body special adhesive pants / reflection [12] (Figure 4) and a laser beam scans in time the human body. With an integrated camera, the system creates in collaboration with the special software a digital mould (copy of the body) on the screen with accuracy of hundredths of mm within five minutes. Among the negative aspects of the methods is that during the scanning the patient should always stay stable and hold his/her breath, standing or at Adams position [1,6,7,13], and in many cases, it is necessary to use a controlled expiration nozzle. The hand-held LASER [2,5,13,14] is considered inappropriate in case of paralytic scoliosis (poliomyelitis, cerebral paralysis and muscle dystrophy), myelopathy, paresis or hemiparesis, in general in cases of muscle weakness [5,15,16].

This method was also used for the control of the correction during the use of the brace. The user accepts a body scans while wearing the brace. Then, the data pass through volume measuring treatment to Mesh Lab or AUTODESK 123D and are compared with the data of the scan without the use of the brace both standing and at right angle position (Adams). All effectuated measurements showed no change in useful volume

Results with the use of Scoliosis Treatment Crass Cheneau® brace With Thoracolumbar (Figures 5-7) scoliosis 25 children (50% of the total) 24 girls, 1 Boy of the girls followed the full programme and the boy. Maximum Thoracolumbar correction up to 99% Average correction 75% with lumbar scoliosis (Figure 6) 10 children (20% of the total) 8 girls, 2 boys only 30% of the girls followed the full programme and one boy. Maximum Thoracic correction up to 80% Average correction 40% with lumbar scoliosis 15 children (30% of the total) 13 girls, 2 boys only 60% of the girls followed the full programme and both boys. Maximum thoracic correction up to 99% Average correction 63%

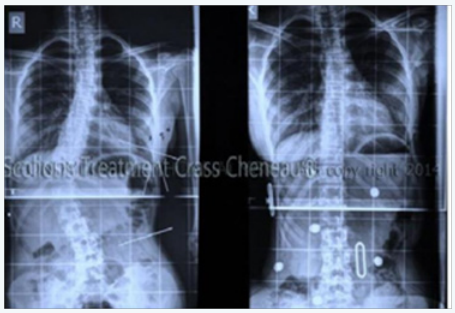

Figure 5: Thoracolumbar scoliosis.

Figure 6: Lumbar scoliosis.

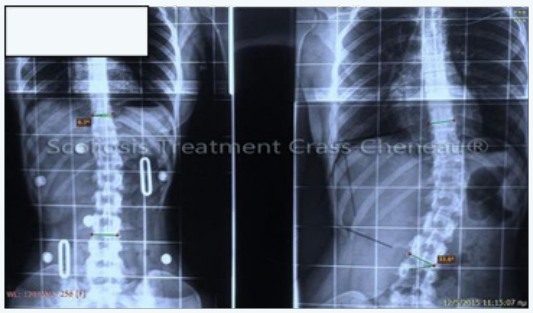

Figure 7: Lumbar scoliosis 15 children.

Somatometric and clinical evaluation Moiré-fringe mapping

Shoulders' asymmetry | Shoulder's asymmetry | Humps| Pelvic asymmetry (obliquity, twist and side rotate) Average 65% of correction 6 months after the first application. All patients showed better body position and appearance within short period of time during their clinical assessment without the brace (Figures 8 & 9). The percentage of correction and appearance depended not only on compliance with the therapy but also

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on: The lack of structural deformities of the spine, the skeletal maturation, the correct use of the brace, the proper execution of the exercises, the weekly exercise in controlled area (swimming-pool) with forty minutes of swimming (freestyle) twice to three times.

Figures 8 & 9: All patients showed better body position and appearance within short period of time during their clinical assessment without the brace.

Conclusion

The use of the new dynamic asymmetric brace Scoliosis Treatment Crass Cheneau®, up to 16 hours per day, in combination with daily exercises of Scroth method and freestyle swimming is particularly effective in lumbar and thoracolumbar idiopathic scoliosis. The hours of use of the brace while sleeping and only eight hours during the day, as well as its discreet shape and lack of any metallic components were of crucial importance for its acceptance by a bigger number of children than we expected. Especially by children having undergone treatment with other type braces (Boston, DDB, etc.) acceptance was 100%.

The use of hand-held LASER scanner during the construction of the brace and during the application significantly increased the limitation and elimination of disturbances (pain, distress, ulcers) caused by other braces, as well as to the maintenance and improvement of the useful oxygen volume, especially in thoracic scoliosis. The use of freestyle swimming combined with daily exercise soon produced (within four months) significantly improved symmetric clinical picture, resulting to positive impact both to children and to parents that altogether considered it of the highest importance. I would like to highlight that at the beginning of the treatment there was no ban or restriction to the activities exercised by the children until then. Regular monitoring (once a month) and discussion with parents and children played a decisive role in psychology and acceptance of the treatment. Moreover, the frequency of visits enabled us to correct the details in the treatment programme that afterwards also played important role [17-28].

During the conservative treatment, monthly observation of the individual file of the adolescent is necessary by the attending physician and detailed account of somatometric changes. One of the most significant elements of the examination of a child suffering from scoliosis is the assessment of the hump(s), which is/are otherwise the pathognomonic sign of organic scoliosis and is/are the element determining the evolution of conservative treatment [29-30]. Clinical evaluation and use of surface topography Moiré-fringe mapping shall define the individual changes that the attending physician should make within the strictly limited schedule of skeletal maturation [31-33]. In all cases, we believe that it would be very interesting a scientific community to create an expanded study in a larger sample of patients using the method Scoliosis Treatment Crass Cheneau®.

Authors' Contributions

All authors have contributed in literature search and review. All authors read and approved the final manuscript

Competing Interests

The authors declare that they have no competing interests.

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