

Polyethylene Orthoses Role in the Management of Bilateral *Genu Valgum*

Preliminary results

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Genu valgum or valgus knee is a disorder caused by the knee deviation in the frontal plane, when the external angle formed between the thigh and calf is less than 170 degrees. The incidence of this disorder is unknown; it can occur sporadically or inside the family and it is one of the most common causes of joint pain. This study describes the properties and the application of a commercial material, AliPlast™ 10, in the case of a 13-year-old patient which presents bilaterally genu valgum deviations. Important improvement in gait and posture were obtained after a 6 months treatment, in which the patient has used the orthoses, combined with physical therapy.

Keywords: *imagistic investigation, Knee-Ankle-Foot Orthosis, non-allergenic, polyethylene foam, thermoformable*

Children are frequently taken to orthopedic surgeons for them to evaluate the axial deformities of the children's lower limbs, especially the ones of the knees. More often encountered are:

-*genu valgum* – represents the deviation of the lower limb axis, characterized by the knees which present an outward opening angle, the lower extremities creating an "X".

-*genu varum* – represents the deviation of the lower limb axis, characterized by the knees which present an inward opening angle, giving the appearance of *parenthesis*.

Parents of the patients in question complain about the cosmetic aspect of the orthostatic deformities, as well as about the walking form. The alignment of the axis at lower limbs follows a predictable model, in relation to age:

-newborns usually have a mild varus bowing along the tibial-femoral segment (10-15 degrees);

-around 18-24 months old, the lower limb axis is almost straightened;

-consequently, a *valgus* deviation will gradually develop, and it will be most obvious around the age of 3-4 (8-10 degrees);

-subsequently, until the age of 7, the lower extremities are in a slight *valgus* alignment, which will modify in a very small extent (it should not be the case and *valgus* should not further develop) [1-3].

Special attention should be given to the family history regarding the existence of these modifications.

Deformity angulation of lower limb axis is measured using a goniometer while the knees are fully extended, and it is documented by performing X-rays and photographs. X-rays are an essential part in evaluating an +18-month old child with pronounced deformities (+20 degrees), when varied *genu valgum/varum* pathological forms, that need orthopedic and/or surgical treatment come into question.

Experimental part

Material

AliPlast™ 10

Applications:

- Effective use for foot orthotics and soft hand splints

Patient Benefits:

- Safe
- Hygienic
- Easily cleaned

Features:

- Thermoformable
- Smooth skin
- Isotropic — bends easily in one direction, stiffer in other
- Liquid, gas and chemical resistant
- Non-allergenic

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- Non-toxic
- Washable

Specifications:

- Closed cell cross-linked polyethylene foam
- Heating temperature: 250-325°F
- Heating time: mm in thickness x 12 = heating time in seconds
- Compressive strength (50%): 75-100 PSI
- Durometer Shore A: 60

Indications:

- Foot orthotics
- Padding
- Soft hand splints Call Points:
- Orthotist
- Orthotic technician
- Prosthetist
- Prosthetic technician
- Pedorthist

Knee-Ankle-Foot Orthosis (KAFO)

There are two very general categories of KAFOs: metal designs and plastic and metal designs. The plastic and metal design is the one most frequently encountered today and is usually a plastic device custom molded to the person's body with metal components in key structural areas only. The reason for the increased use of the plastic and metal design is that it is lighter in weight and is considered to be more cosmetic [4, 5].



Fig. 1. Different models of Knee-Ankle-Foot Orthosis

Case study

13-year-old patient presents bilaterally *genu valgum* deviation, more severe on the left. Axial deviation had installed over a 3-4 month time period on the basis of a growth spurt of the child (current height: 176 cm), progressing rapidly and causing walking abnormalities. Imagistic investigation showed a 15-degree axial tibial-femoral angle of the right knee, and 20-degree angle of the left. Treatment, in such cases, imposes a surgical intervention, by performing epiphysiodesis. Preoperatively, it is necessary to complete a kinesitherapy program, in order to preserve muscle strength.

Rehabilitation program

The patient followed a daily exercise-based program in the outpatient Rehabilitation department for 1 month. The goals of the rehabilitation were: to strengthen the hip abductor muscles, to strengthen the quadriceps, to strengthen the gluteal and external rotator muscles, to improve awareness of knee position during walking gait, to improve whole body balance and to improve postural control during balance [6,7].



Fig. 2. Patient presents bilaterally *genu valgum* deviation

The patient performed side plank, side step-ups, stationary lunge and single-leg bridge exercises in 2 sets of 10 repetitions of each exercise. Side plank exercises strengthen the hip abductor muscles on the outside of the thigh helping pull the knee and hip outward the *valgus* position. Side step-ups strengthen both the hip abductor muscles and the quadriceps maintaining thus a proper knee alignment and adding stability to the joint. Stationary lunge exercise works the quadriceps and helps prevent an inward knee angle. Single-leg bridge exercise strengthens the gluteal and external rotator muscles in the buttocks. These muscles counteract the inward rotation of the hip that occurs with knee *valgus* [8].

Parents are opting to delay the surgical intervention for a period of nine months, until the end of the school year. Consequently, it has been agreed upon combining kinesitherapy and immobilization during the night, using an articulating knee-ankle-foot orthosis, which allow points of pressure on the knees, from medial to lateral. The orthoses were made from thermoformed polyethylene. After a period of 6 months, in which the patient has used the orthoses, combined with kinesitherapy, improvement in gait and posture was clinically recorded. Femoral-tibial angle imaging measurements indicate the same values as the initial examination, signifying stabilization of *genu valgum* [9-11].

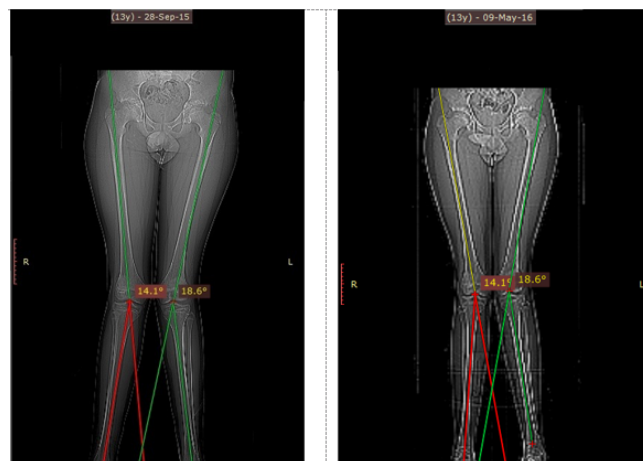


Fig. 3. Scanography with angles measured (a) initial and (b) after a 6-month treatment

Conclusions

Genu valgum modifications in posture and gait, often lead to parents addressing the pediatric orthopedic surgeon, and are even more unsettling when the installment interval is shorter, and the age is older. The treatment is complex, lengthy and combines multiple therapeutic possibilities. Orthotics plays an important role, given that creating such device from thermoformed polyethylene allows each case

to be customized. Furthermore, it presents the advantages of using a hypoallergenic, lightweight, and resistant over time fabric, which can withstand subsequent corrections by simply reheating in high temperature for short durations.

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