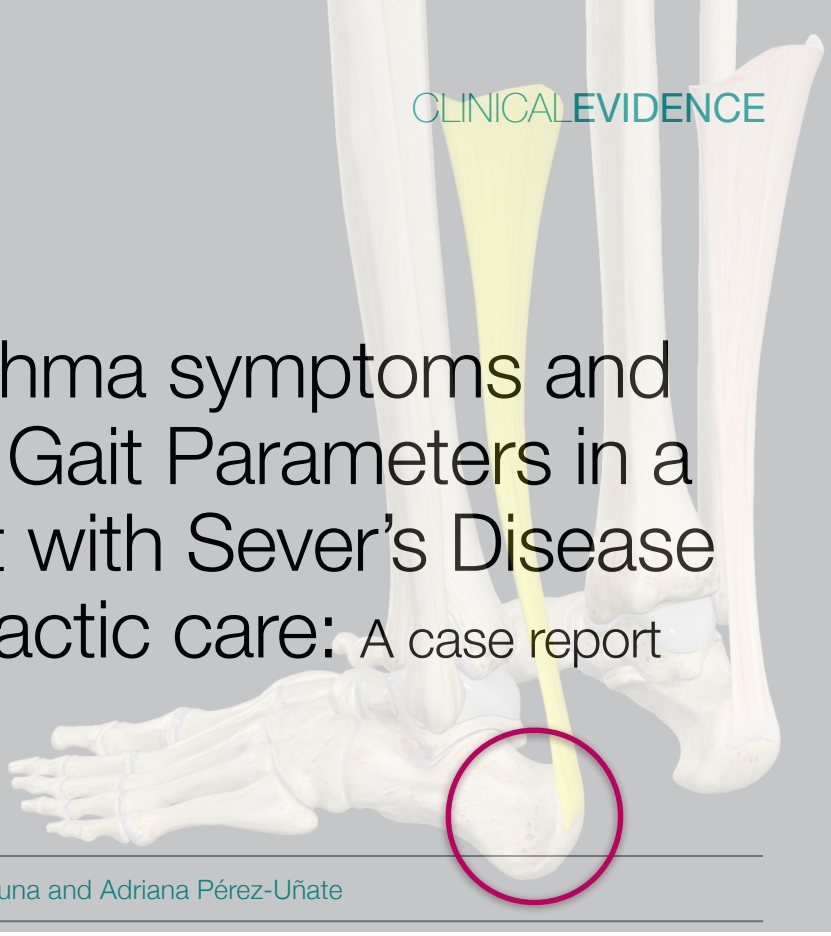
Asia-Pacific Chiropractic Journal

CLINICAL EVIDENCE

Resolution of Asthma symptoms and Improvements in Gait Parameters in a paediatric patient with Sever's Disease receiving Chiropractic care: A case report



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Abstract: The purpose of this paper is to discuss the positive outcomes obtained with a multimodal program of chiropractic care in a paediatric patient who suffered from asthma and Sever's disease.

A 9-year-old male patient was brought into a Chiropractic clinic by his parents looking for a second opinion for a diagnosis of bilateral Sever's disease. During the examination, it was found that he also suffered from asthma. The patient received 17 chiropractic adjustments in a span of two months, averaging a frequency of twice per week, and then was re-evaluated.

Improvements were observed in the severity of foot pain, objective gait parameters, and asthma symptoms. The results of this case study provide evidence that a multimodal program of chiropractic care can improve foot pain related to Sever's disease, gait parameters, and asthma in paediatric patients. More research with a more robust design is necessary currently to establish a cause-and-effect relationship between chiropractic care and the conditions above mentioned

Indexing Terms: Chiropractic; biomechanics; gait analysis; pediatric (paediatric) chiropractic; Sever's disease; asthma.

Introduction

Lower extremity conditions are commonly seen in chiropractic offices around the world. Research suggests that up to 17.5% of the care rendered by chiropractors is directed at conditions of the extremities. (Hoskins et al, 2006)

Sever's disease (SD) is of common occurrence in the paediatric population and the condition has been described as one which causes pain in the posterior heel and is more common in children from 8 to 15 years of age. (Ogden, 2004) This age range correlates with the time when the apophysis of the heel is open. The pathophysiology of the condition considers the repetitive traction of the Achille's tendon affecting the secondary ossification centre of the calcaneus, (Launay, 2015) and current conservative treatment includes modification of activity levels, shoe design, the use of heel cups and gastrocnemius stretches. (Atanda et al, 2011)

> *... Sever's disease is a painful affliction of the young, and in this case the patient had an overlay of asthma. Appropriate clinical investigations were made and a global treatment plan applied. The patient showed essential resolutions'*

Children and adolescents engaged in high rates of physical activity seem to be at a greater risk of developing the condition, which is more common in boys. (Launay, 2015; James et al, 2013) A few research articles have investigated the incidence of SD. A study reviewing 16,383 files of children between the ages of 6-17 revealed that the incidence was 3.7 per every 1,000 (Wiegerinck et al, 2014). In youth German soccer players Belican et al, (2022) found the incidence of the condition to be .36 per every 100 athletes per year. Finally, in a study looking at data from a paediatric clinic, the researchers found that 5% of the overall musculoskeletal issues patients presented with were due to *calcaneal apophysitis*. (de Inocencio, 1998)

Asthma

Asthma is a global issue that affects all age groups. In the paediatric population an increase in prevalence has been observed in recent years. (Global Initiative for Asthma, 2019) Current paediatric asthma prevalence is stated to be around 7%, with school-age children having a prevalence of 8.6%. In males below eighteen years of age, the prevalence is 8.4%. (Centres for Disease Control, 2022).

The condition affects the airways of the lungs through an inflammatory process making them narrower and therefore causing breathing difficulties. It is characterised by symptoms such as coughing, wheezing, shortness of breath, and chest tightness. Most treatment approaches in traditional medical care are focused on the prevention of asthma attacks by minimising exposure to triggers and the use of control medications, which include bronchodilators, corticosteroids, and biologics. In the event of an active attack, a '*rescue*' medication is recommended, and this includes beta2-agonists, anticholinergics, and corticosteroids. (Sharma et al, 2022) Chiropractors regularly take care of patients suffering from this condition, and research evidence suggests positive changes in paediatric asthma after chiropractic care. (Kaminskyj et al, 2010; Alcantara et al, 2012)

The purpose of this paper is to discuss the positive outcomes obtained with a multimodal program of chiropractic care in a paediatric patient who suffered from asthma and Sever's disease.

Case Report

A 9y male patient (142 cm/53 kg/26.3 BMI) was brought into a chiropractic clinic by his parents on April 1st 2021, looking for a second opinion for a diagnosis of bilateral SD. This diagnosis was performed by the child's paediatrician who recommended physical therapy as treatment. According to the parents, little improvements were observed with 2-months of physical therapy. The pain was rated by the patient as a 6/10 on the right side and 7/10 on the left side, it worsened upon palpation, and it was located at the posterior and inferior aspects of the calcaneus bone on both feet.

A secondary complaint of asthma was described by the parents, and they revealed that their son was initially diagnosed at age six months after he was hospitalised with breathing difficulties. Multiple medications have been prescribed to the patient throughout his life. These medications include bronchodilators and corticosteroids, and for the last 2-years, an *Albuterol* inhaler was used before any type of physical activity, which was at least three times per week. The *Childhood Asthma Control Test* (C-ACT) was administered to the patient, this tool is a validated instrument utilised to quantify asthma control in children of ages 4-11 years old. (Liu et al, 2007; Voorend-van Bergen et al, 2014). At the moment of the initial evaluation, the score for the patient on the C-ACT was 17, which indicated a poorly controlled condition.

A chiropractic evaluation which included a 2D postural examination, palpation of the calcaneus bone, paraspinal infrared thermography, and full spine radiographs was performed. Furthermore, the patient's gait was analysed utilising an innovative insole inertial measurement

unit (IMU) system. Informed consent was obtained from the parents of the patient before the submission of this manuscript. To evaluate 2D posture the software *PostureScreen*® (PostureCo, Inc., Trinity, Florida, USA) was used. This software has previously been shown to be valid and reliable. (Boland et al, 2016; Szucs & Brown, 2018). Multiple postural alterations were observed during the evaluation, this can be observed in figure #1.

From the anterior view, a left high shoulder was observed, from the side view a forward head posture (FHP) was noted, and from the posterior view a left head rotation and left pelvic drop were also observed. Interestingly, verbal and visual cues to stand up straighter were unsuccessful in improving his rotated posture on the posterior view. This could potentially be due to reduced proprioception from spinal distortions, (Haavik &Murphy, 2011) or from an alteration in the visual field as he was close to the wall for that evaluation. (Alcock et al., 2018) Radiographic evaluation can be observed in figure #2.

Figure 1: 2D postural analysis pre- (left) and post-treatment

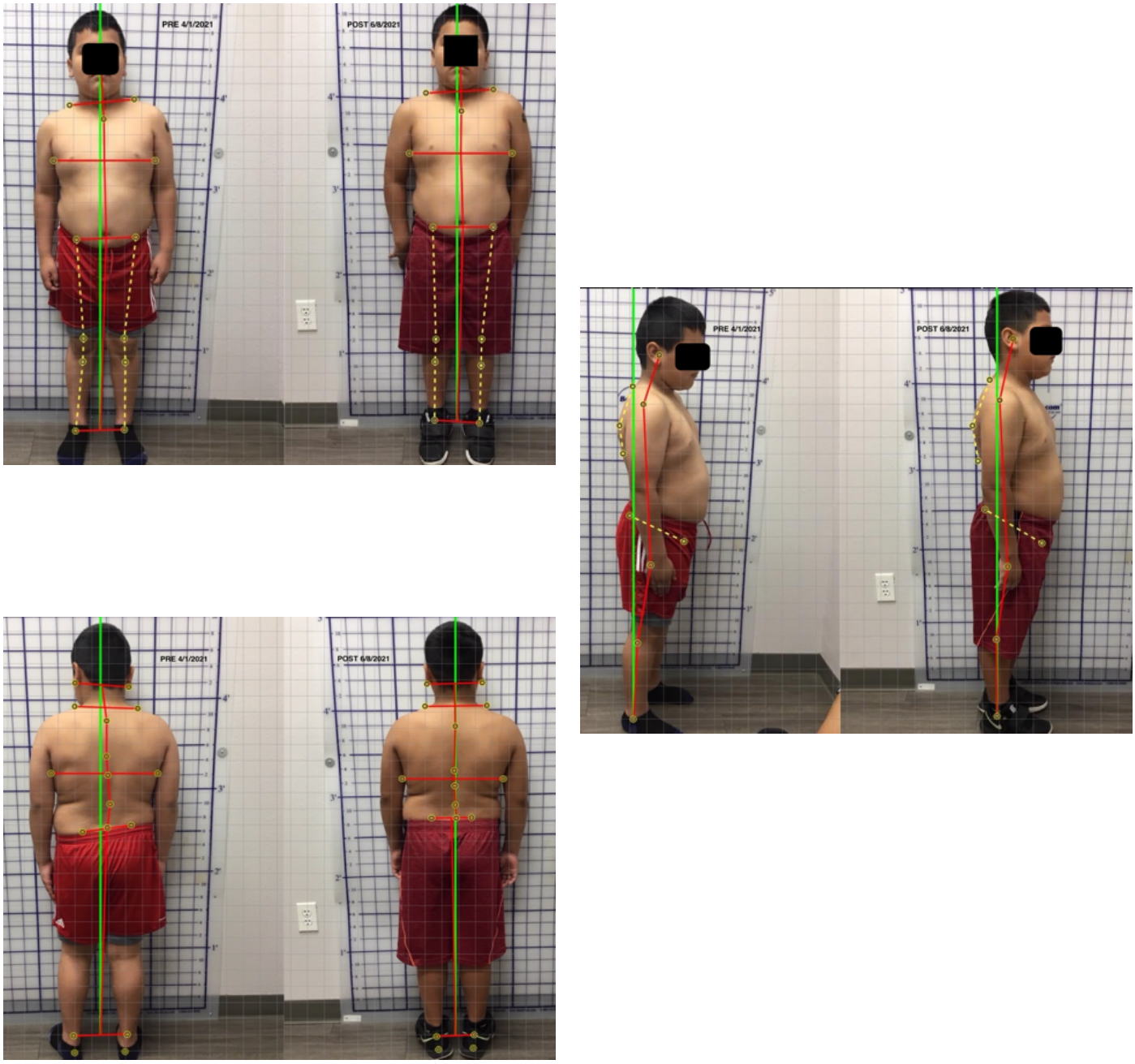
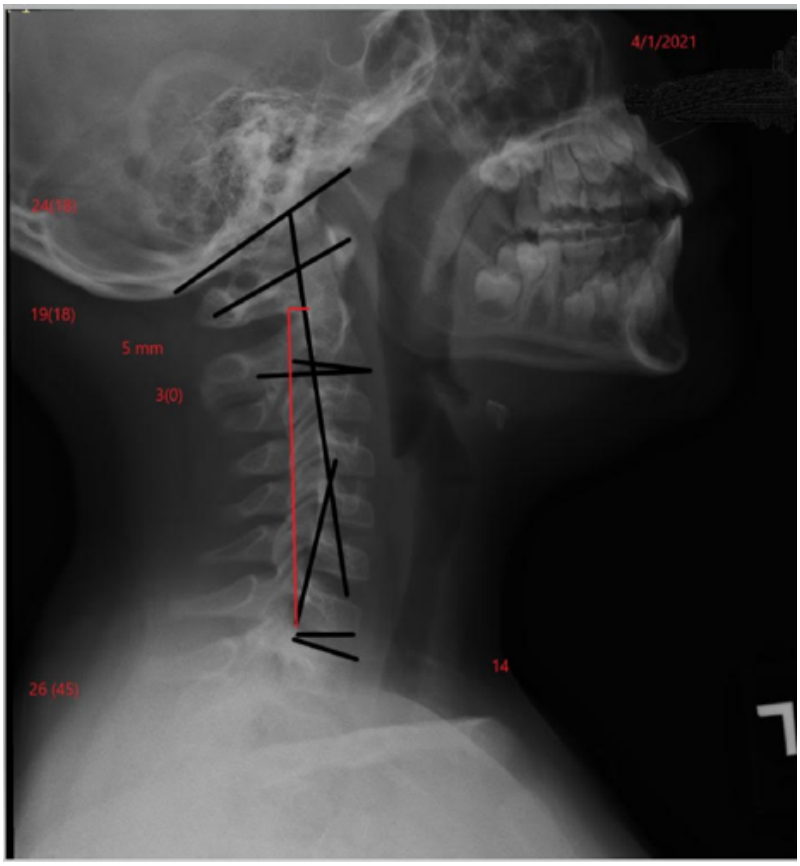
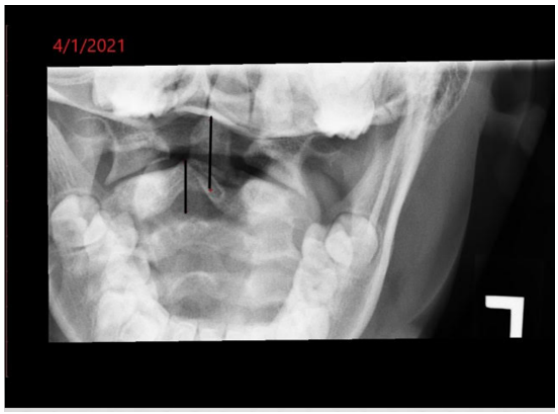
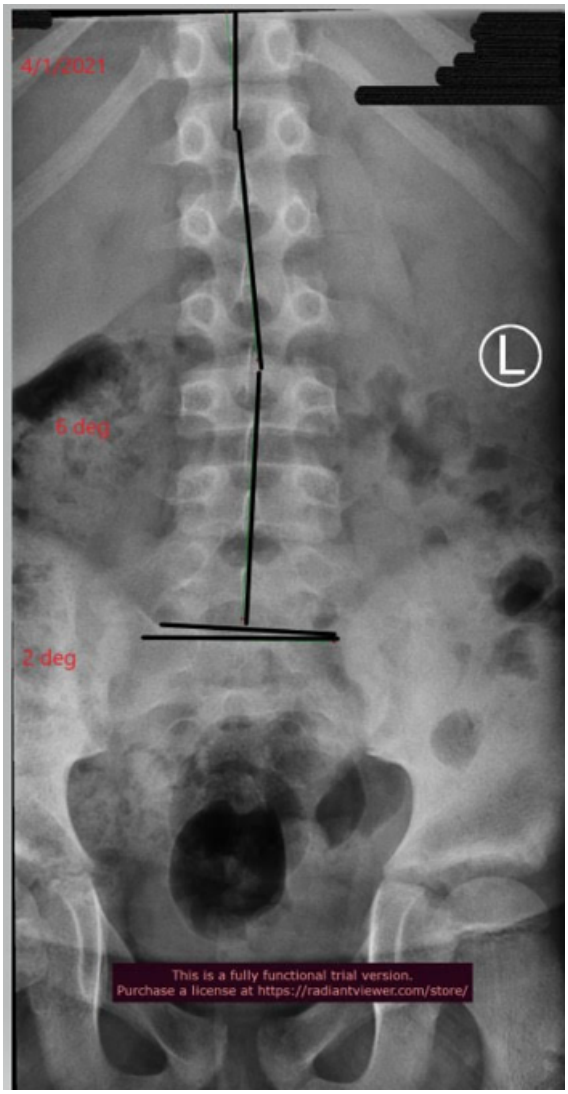
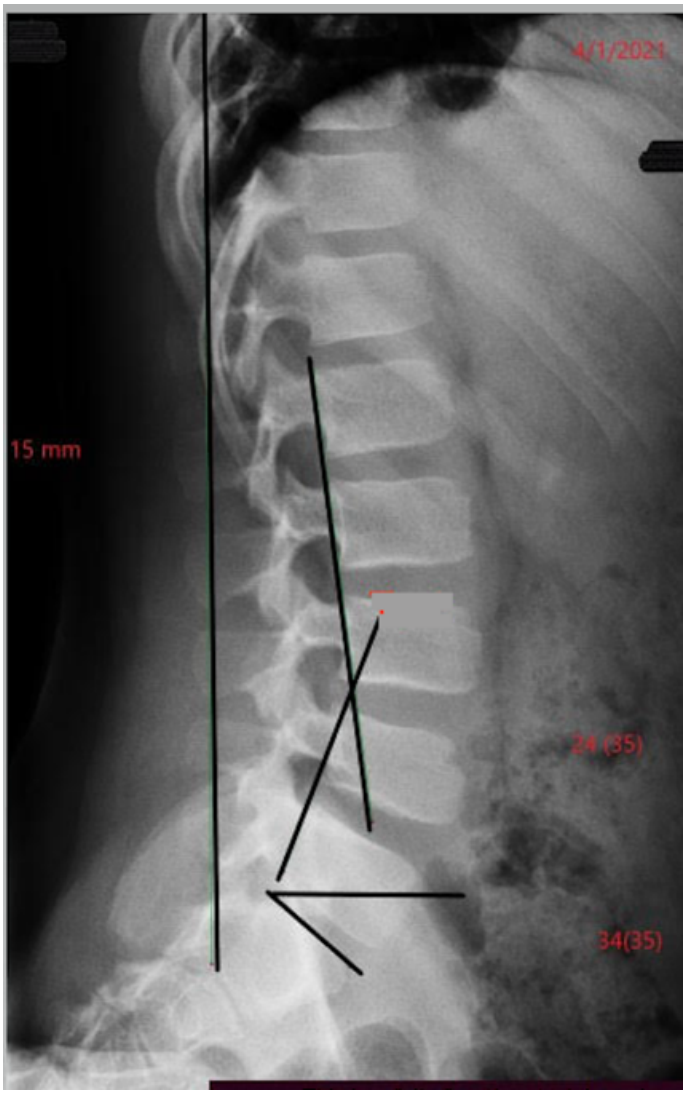


Figure 2: Radiographic analysis obtained during the initial visit.



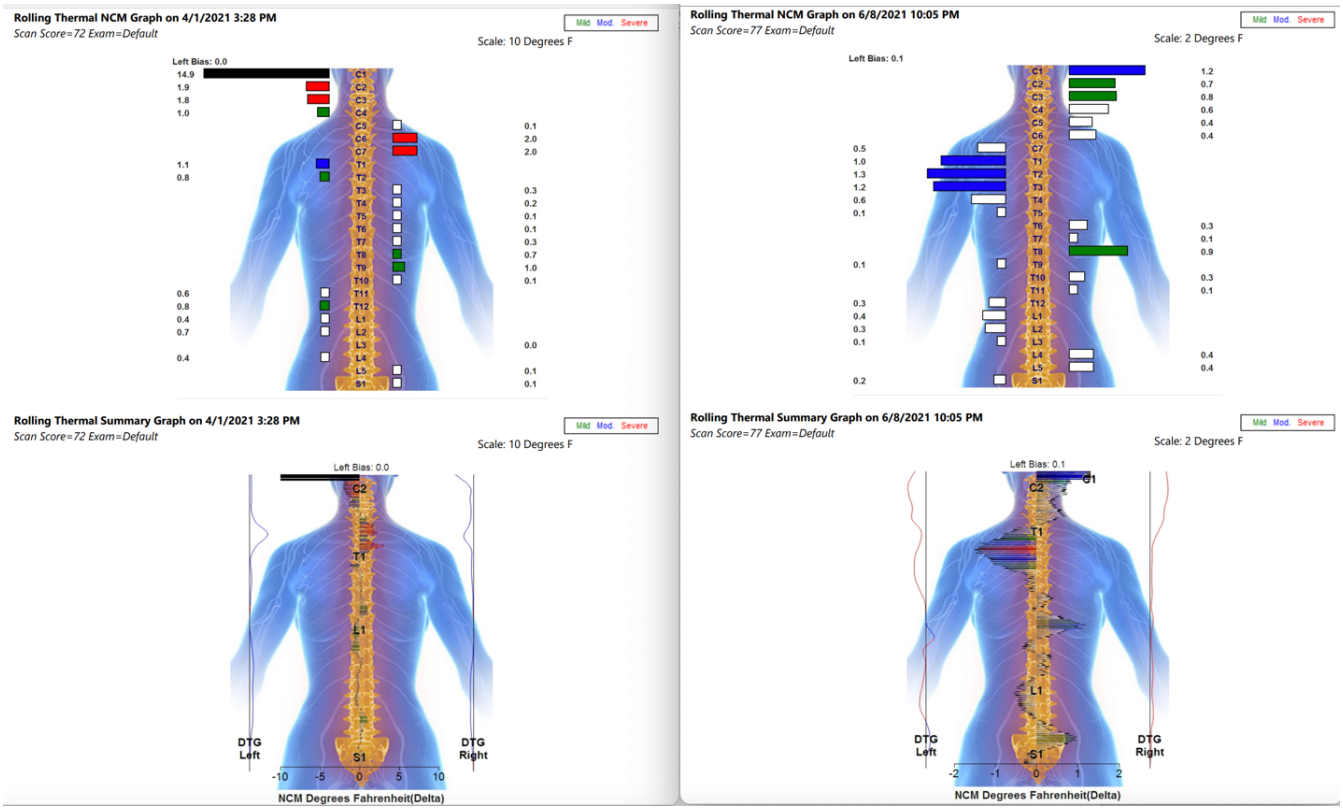






Para-spinal infrared thermography was performed with the INSiGHTTM neuroTHERMAL (Chiropractic Leadership Alliance, Inc., Las Vegas, Nevada, USA) scan which has been found to be a reliable instrument to assess temperature differences from one side of the spine to the other. (McCoy et al, 2011) The findings can be observed in figure #3. Palpation of the calcaneus proved to be difficult during the examination due to the level of pain to touch the patient experienced. The goal of this examination was to find potential restrictions of motion in the subtalar joint plane of movement that could be improved upon with care. Also, upon visual inspection, a bilateral loss of the arch of the foot was noted.

Figure 3: Before (left) and after (right) paraspinal thermography evaluation



Objective gait analysis was performed utilising the *Senno Gait Portable Gait Analysis System* (Shenzhen Xingzheng Technology Co., Ltd, Shenzen, China). This system is composed of a 6-axis accelerometer and a 6-axis gyroscope. This instrument is known as an (IMU) and has been previously validated against optoelectronic cameras, which are the gold standard in human movement assessment. (Zhuolin et al, 2017) The sensor is inserted into a rubber insole which is then placed into the patient's athletic shoes (see figure #4). The patient was instructed to walk at a normal and comfortable speed (self-selected) for 20 meters while a wireless Bluetooth connection streamed live data directly to an iPhone which housed the application. Spatio-temporal parameters as well as stance analysis, and swing analysis were some of the metrics derived from the IMU's.

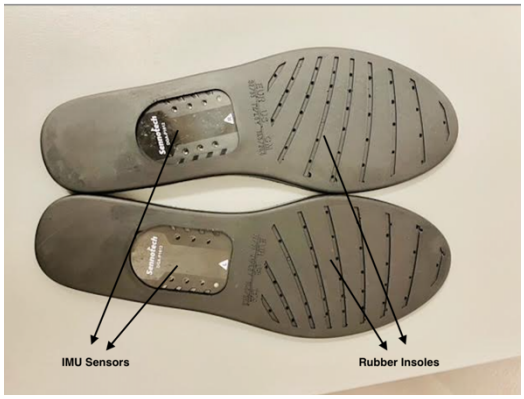


Figure 4: Senno Gait Portable Gait Analysis System

Intervention and Outcomes

The patient was recommended a multimodal program of chiropractic care which included aspects of the *Chiropractic Biophysics Technique*® (CBP) and the *Pettibon System* with the goal of correcting '*global*' spinal subluxations. (Kent, 2006) The program included manual and instrument-assisted chiropractic adjustments based on radiographic analysis which were performed in an Omni drop table. The *Arthrostim* (IMPAC Inc., Salem, OR, USA) adjusting instrument was also used during the care. Manual mobilisation of the subtalar joint was also performed in the specific direction of hypomobility of the joint.

In-office postural correction exercises included: standing repetitive traction, tridimensional wobble seat exercises, and specific use of head and body weights while standing on a whole-body vibration platform (WBV) (The VibeTM, Home Spinal Rehab, Minnesota, USA). Home exercises included Mirror image® cervical extension exercise using the *Pro-Lordotic* elastic resistance band (Circular Traction Supply Inc., Huntington Beach, CA, USA) and a three-point bending traction device known as *Denneroll™ Spinal Orthotic* (Denneroll Pty Ltd, New South Wales, Australia).

The initial recommendation included visits at a frequency of three times per week for 4-weeks, but because of conflicts in schedule, the patient received only seventeen adjustments from 4/1/2021 to 6/8/2021 averaging two visits per week. At that point, a re-evaluation was performed. During the re-evaluation, the patient reported a significant reduction in pain from 6/10 on the right side to 2/10, and from 7/10 to 2/10 on the left side. Also, upon palpation of the calcaneal area, there was no pain noted by the patient. The loss of arch remained the same as at the initial evaluation.

The C-ACT revealed a significant improvement in asthma control as the score improved from a 17 (poorly controlled asthma) to a 26 (well-controlled asthma). It is very important to mention that the minimal important difference (MID) or the minimal score that dictates a clinically meaningful change (improvement) for the patient on this tool is 1.6 points (Voorend-van Bergen et al., 2014), meaning that the patient, in this case, had a very large improvement (9 points) in asthma.

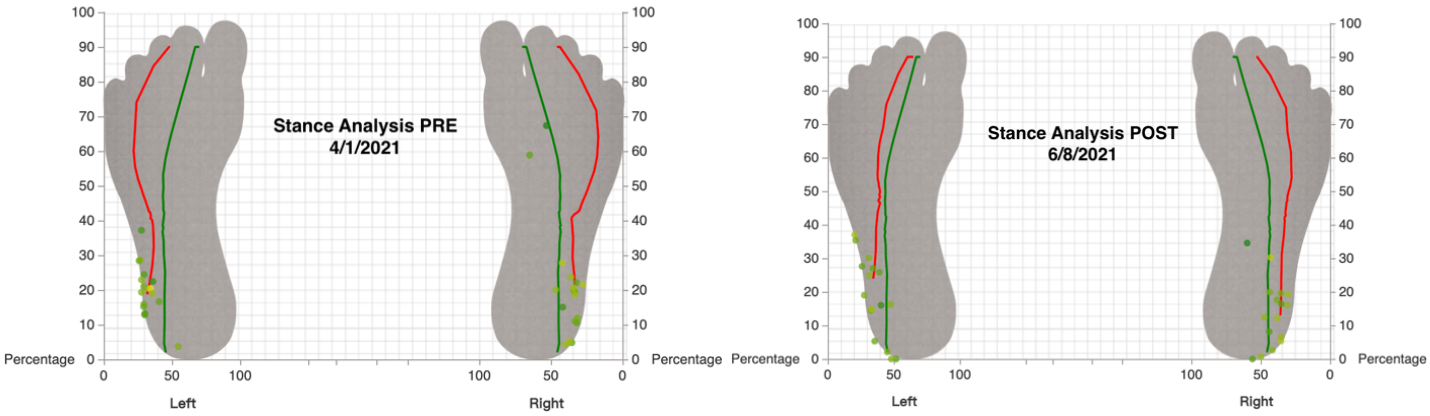
Improvements in gait parameters can be observed in table #1, and the stance analysis showed an improved centre of pressure (CoP) distribution (figure #4). Furthermore, before and after 3D motion graphs can be observed in figure #5.

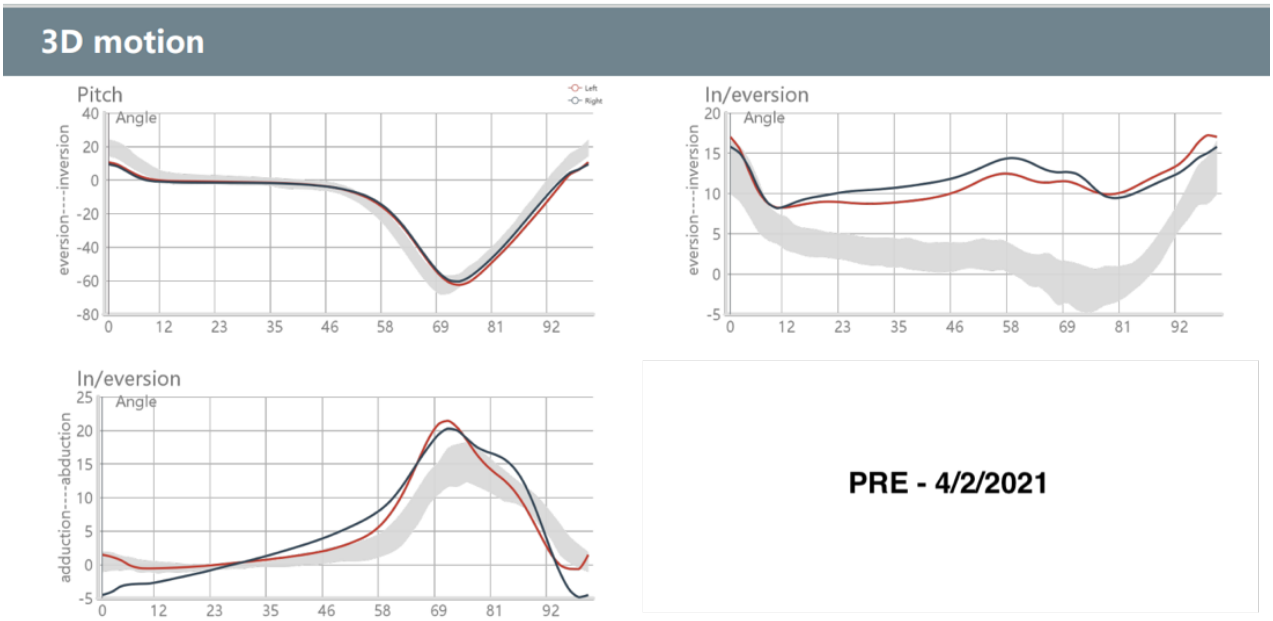
Finally, postural improvements included levelling of the shoulder from the anterior view, considerable improvement in the FHP from the side view, and correction of head rotation and pelvic drop from the posterior view (figure #1). After this progress evaluation, the patient was recommended a wellness/maintenance chiropractic care plan.

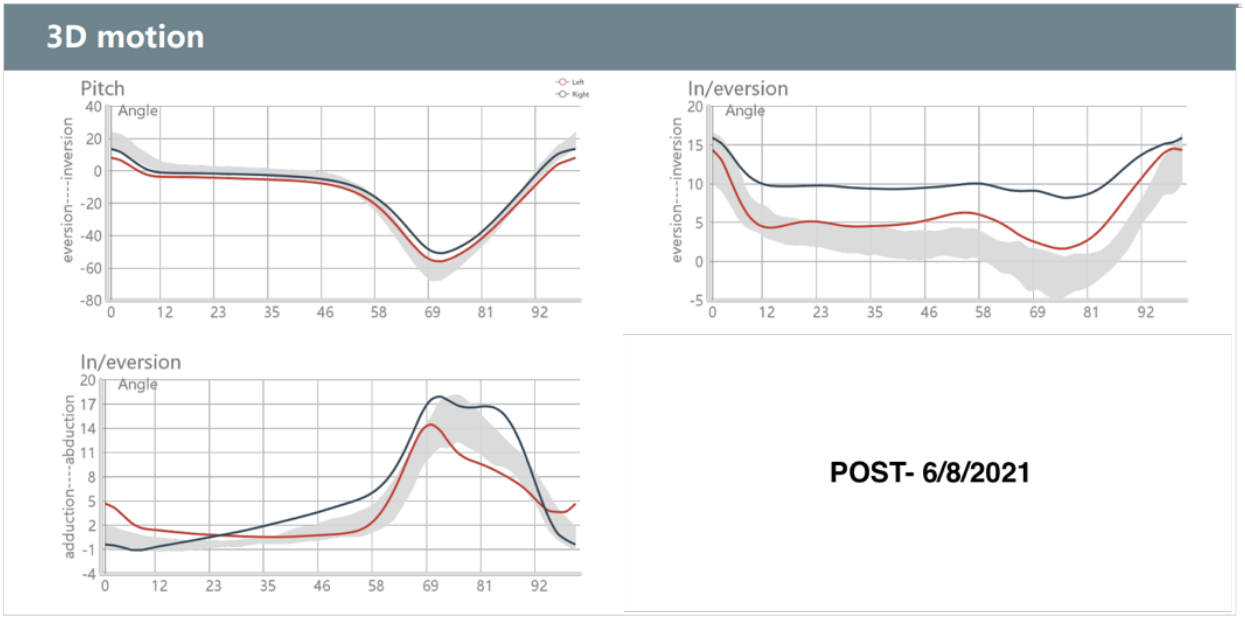
Table 1: Results from swing and spatial analysis obtained from the IMU's. ASL refers to average stride length in meters, MSH is the maximum swing height in meters and SV refers to swing velocity in meters per second. HAS is the heel strike angle in degrees, SIA is the strike inversion angle in degrees, and TOA is the toe out angle also in degrees.

	ASL Left	ASL Right	MSH Left	MSH Right	SV Left	SV Right	HSA Left	HSA Right	SIA Left	SIA Right	TOA Left	TOA Right
Pre	.99	.99	.17	.16	3.13	3.17	10.78	11.56	18.20	17.41	10.13	1.64
Post	1.07	1.07	.15	.13	3.45	3.71	10.64	14.13	16.41	15.31	7.55	4.32

Figure 5: 3D motion graphs in the sagittal, frontal, and horizontal planes before and after receiving chiropractic care. The red line refers to the left foot, the blue line to the right foot, and the gray band is the normative range where both should be during the gait cycle.







Discussion

The purpose of this paper is to discuss the positive outcomes obtained with chiropractic care in a paediatric patient who suffered from asthma and SD. Importantly, only two studies were found in the chiropractic literature that dealt with the treatment of SD. Leri (2004) reports a case of a youth baseball player who had suffered from medial calcaneal pain on his right foot for three days before visiting a chiropractor. The treatment plan for this patient included mobilisation of the subtalar and forefoot regions, manipulation of the ankle mortise region of the ankle joint, cold packs, and electrical stimulation. Stretching exercises of the Achilles tendon and plantar fascia were also recommended as home care. The patient reported positive improvement in pain and movement and was able to resume normal sports-related activities (baseball) within one week.

Second, a retrospective case series that included eleven athletes with some form of juvenile osteochondrosis (8 with SD) delineated the improvements in the *Lower Extremity Functional Scale* (LEFS) after a short-term multimodal chiropractic intervention. (Olson & Hinkeldey, 2018) The treatment of those with a diagnosis of SD included: manipulation of the *talus* and/or *calcaneus* bones, myofascial release, and instrument-assisted mobilisation of the *gastrocnemius*, *soleus*, and *hamstring* muscles as well as the Achilles tendon. Kinesiological tape was also applied at the end of the treatment session over the muscles treated and stretches utilising the post-isometric relaxation protocol were taught to the patients for home care focusing on the calf and hamstring musculature. The improvement in the LEFS in this group of patients ranged from 10 to 40% at the moment of discontinuing care.

There is a paucity of data on the subject of gait analysis and chiropractic care with only seven studies found in the chiropractic literature. In the late 80's Robinson et al (1987) used a force platform to quantify temporal and kinetic parameters of the gait cycle in nine patients with '*sacroiliac dyskinesia*'. Subjects who had asymmetrical gait parameters before the chiropractic intervention tended to have increased symmetry aftercare. Ward et al (2013 & 2014) performed two separate pilot studies utilising high-precision optoelectronic cameras in pre and post fashion, and in both studies, no statistical differences between pre and post chiropractic interventions were found. The authors suspected that the small sample size was to blame for the lack of differences in gait parameters.

In a different study, subjects with sacroiliac pain between the ages of 18-50 were evaluated for gait parameters utilising force platforms and high-speed video cameras. The authors found that chiropractic intervention caused significant and measurable changes in the walking parameters of most subjects, but only symmetry was found to have a systemic effect in the entire subject population. (Herzog, 1991) Russel et al. (2018) published a case report describing the care and changes in kinetic and kinematic parameters of the gait cycle in a patient with a fifth metatarsal fracture. The authors concluded that measuring gait cycle parameters before and aftercare allowed for more objective quantification of the improvements in symptoms.

Finally, two recent cases published by Chu and collaborators (Chu, Wong & Lee, 2021; Chu & Wong, 2022) delineate positive changes in gait cycle parameters using an instrumented treadmill in two patients with Parkinson's disease (PD) who receive a multimodal treatment program that included chiropractic care. In the first study, a male taxi driver diagnosed with Parkinson's disease received chiropractic treatment which consisted of thermal ultrasound therapy and high-velocity low amplitude (HVLA) spinal manipulation to the upper thoracic and lumbar spine to improve intersegmental restrictions. During the second phase of care, intermittent motorised traction was added to the treatment plan. The patient was seen daily for five consecutive days and then three times per week for eleven weeks at which point was re-evaluated. Significant improvements were observed, and the gait process stabilised which was evidenced by an

accurate foot stride, regular heel strike, and symmetric center of pressure crossover between strides depicted on the gait cyclogram. (Chu, Wong & Lee, 2021)

In the second study, a sixty-nine-year-old female also diagnosed with PD received chiropractic treatment that consisted of lumbar spinal manipulation, intermittent lumbar traction therapeutic ultrasound, massage, and balance exercises. After three months of treatment at a frequency of two visits per week the patient had significant improvements. Improvements in the gait process were observed by a more accurate foot stride, a regular heel strike, and a symmetric and rhythmic centre-of-pressure crossover between strides as shown by the gait cyclogram. An improvement in foot pressure and regular stance phase was also observed. (Chu & Wong, 2022)

Even when chiropractic does not offer treatment for asthma, certain research has shown good results in paediatric patients suffering from the condition. In their review of the literature, Alcantara et al (2012) found positive evidence for the use of chiropractic care in patients with asthma. The research team found three randomised controlled trials, ten case studies, three case series, seven cohort studies, three survey studies, five commentaries, and six systematic reviews. It is important to note that of the three clinical trials reviewed by the researchers in this study two of them showed positive results in either patient-rated methods, spirometry-based evaluations, or reduction of medication usage. Even though the number of studies on this subject is limited since the evidence-based model encourages the use of clinical experience and the best available evidence at the moment clinicians should consider the use of chiropractic care in asthmatic patients. Alcantara et al (2012) concluded that chiropractic care can offer an alternative care approach for asthmatic patients in an integrative healthcare setting.

Conclusion

The results from this case report revealed that a multimodal program of chiropractic care with the goal of correcting '*global*' spinal subluxations was effective at improving Sever's disease, and asthma in a 9y male patient. Also, improvements were observed in certain gait parameters in the child using an IMU system.

More research, with a larger sample size, is necessary at this time to be able to obtain more robust data and therefore be able to establish a cause-and-effect relationship between chiropractic care and improvements in asthma and Sever's disease.

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Cite: Osuna A, Pérez-Uñate A. Resolution of Asthma symptoms and Improvements in Gait Parameters in a paediatric patient with Sever's Disease receiving Chiropractic care: A case report. Asia-Pac Chiropr J. 2023;3.4:Online only. URL www.apcj.net/papers-issue-3-4/#OsunaSevers.

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