The Importance of Treating Feet in Children with Down syndrome

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The Responsibility of the Pediatric Podiatrist

The goal of any practitioner, no matter what their specialty, should be to better the lives of their patients using every tool available to them without bias. As podiatric physicians we have the unique ability to use all forms of medicine, including surgery, on our patients. It is my belief that a well-rounded podiatrist should be someone who recognizes the implications of foot ailments at the earliest of ages in order to prevent adult problems. That is why I have chosen to specialize in podopediatrics.

The feet are the foundation of the body, and from the first step a child takes, deficiencies in the lower extremity begin to create a destructive domino effect on the rest of the human body. It is our job as podiatrists to make sure the feet are taken care of. Whether a child has a simple or complicated medical history, their feet should be screened and treated like those of anyone else. Children with the diagnosis of Down syndrome are no exception.

"Normal" Development of the Pediatric Foot

Let's talk about what should occur with foot maturation of any child regardless of other medical diagnoses. At the age of 2 years old, the heel bone should sit at about 4 degrees or so everted (means that when you look from the back of someone the heel bone looks like its collapsing down and in.) From 2 years old until 6 years old the "normal foot" should lose about 1 degree of the "eversion" per year and at the age of 6 the heel should stand somewhat "straight up." This allows an arch to be present. The foot support is on the outside, bringing the center of gravity to a more neutral stance. Another phenomenon that is "supposed to happen" as we grow older from the age of 0-6/7 is that our lower leg bones start to turn out, and we get a more erect stance. For a majority of those with Down syndrome these two "normal" processes do not occur adequately.

The Down syndrome patient

In a patient diagnosed with Down syndrome, there are a multitude of concerns which may be present involving the heart, digestive system, spine, eyes, intellect, joints and mobility. Individuals with Down syndrome typically have problems with collagen, which is the major protein that makes up ligaments, tendons, cartilage, bone and the support structure of the skin. This creates significant laxity from the feet up, thus beginning at a young age the life long destruction of the kinetic chain. "Almost all of the conditions that affect the bones and joints of people with Down syndrome arise from the abnormal collagen found in Down syndrome."[1] The resulting effect in 88% of the Down syndrome population is hypotonia, ligamentous laxity and/or hyper-mobility of the joints.[2] The combination of this ligamentous laxity and low muscle tone contribute to orthopedic problems in people with Down syndrome.

Within the feet, the most common foot problems which can be found in the Down syndrome patient are "digital deformities, hallux abducto valgus, pes plano valgus, metatarsus primus adductus, hyper mobile 1st ray, brachymetatarsia, haglunds' deformity, syndactaly and Tailors bunion."[2] Genu valgus and subluxation and/or dislocation of the patella are another concern due to this condition. Hip and spinal issues are often seen as well.[1]

Overall laxity of the feet has been reported in 88% of children with Down syndrome.[3] This percentage is far higher than those without, yet what I see is that often their feet are ignored. The primary medical diagnosis seems to trump the importance of good foot health. I'm here to say it should not. All medical issues should be addressed.

Specifically the feet

Many patients with Down syndrome have flat feet due to laxity, which we know will not cure itself. We need to screen for this early. This troubling flexible flat foot can be spotted at a

FIGURE 1: A patient of Dr. DeCaro's successfully completing a climb to the top of a mountain for the first time utilizing the correct foot support. Functional orthoses can significantly increase the active lifestyle of a child diagnosed with Down syndrome.

very young age. Unlike many children though, this flat presentation does not go away by the age of 3 but continues causing foundational destruction to the rest of the body as the years go on.

What I have seen with my young Down syndrome patients is an inability of the heel bone to come out of eversion. When that happens the arch, the ankle, and inevitably the rest of the body stay flat and become "dragged down" toward the midline. This causes many kids with DS to have trouble sustaining good strength when they stand and building good core musculature. This "collapse" will impair normal external rotation of some long bones of the body, which leads to multiple postural changes. As well, when physical therapy is called upon to strengthen the child, failure or delay of achieving a strong kinetic chain is inevitable. You can't build on a poor foundation! Not only will the structure not support it, but due to poor foot alignment the muscles during the exercises may not even fire.

Quality of life factors for Down syndrome patients

According to Benoit, "when a person has limited ability for movement, there is bound to be some restriction in exposure to learning opportunities and social stimulation, and this privation tends to be reflected in depressed intellectual ability."[4] In other words, by allowing the patient to be more mobile, the patient's overall well being will be increased. This is critical since those with Down syndrome are living twice as long as they were 25 years ago.[5] In fact, studies have shown that those with Down syndrome live longer when they have developed good self-help skills.[6] What better way to encourage self-help than to enable a patient to walk, run and be physically active over the course of a lifetime? It is a known fact that with Down syndrome comes an increased incidence of Alzheimer's disease. With that typically comes an increase in proteins called Amyloids. Researchers at Washington University in St. Louis found that there was a correlation between a sedentary lifestyle and a higher level of amyloid deposition.[7] Thus, the science is once again telling us that inactivity can lead to an early demise.

Obesity is also common in Down syndrome patients, partially due to inactivity. By correcting the biomechanics, inactivity may be lessened and quality of life may be increased. (FIGURE 1)

Treating the pediatric foot

As a pediatric specialist, now with 11 years of experience, what I find troubling is that identifying problem feet at an early age is non-existent in the medical community. This is especially true in those with Down syndrome. Not only are the feet typically last to be looked at but also being that there can be a plethora of other ailments, the feet get little notice. I try to base my practice on the simple fact that "feet are feet!" A person's foot type is their foot type no matter what medical condition they may or may not have. Unbeknownst to them, many practitioners fall guilty of not recognizing and treating important issues like flat feet when they become

focused on what they deem "larger problems." I have made it a personal mission of mine to get out to groups across the country, such as parental Down syndrome support groups, pediatricians, fellow podiatrists, Early Intervention specialists, PT's and OT's and various other specialists, and lecture on the importance of recognizing the feet and its association of their improvement with improved quality of life.

Most common foot types in Down syndrome

There are six major categories of foot types (www.whatsmyfoottype.com) in the adult population, each becoming apparent as early as age 6 or 7. When a podiatrist treats a patient with Down syndrome, whether an adult or a child, the biomechanics of the feet and lower extremities need to be analyzed closely and each patient needs to be foot typed. Frequently, patients with Down syndrome have a D foot type with a neutral to mildly compensated rearfoot and a neutral forefoot. As the child matures to adulthood, this foot type can often progress to an F foot type where the heel rotates even more, causing the person to strike the heel on the inside. This creates more collapse of the subtalar joint, which pulls the entire medial side of the kinetic chain downward resulting in genu valgus, knee torsion, and greater hip rotation. This is a very inefficient foot type causing early fatigue and muscle pain. (FIGURE 2) It's like every step the child takes is in quick sand. Let's quickly review the specifics of these two common foot types.

The **D Quad Foot Type** is a moderately over-pronated foot-type. This foot-type occurs when a Compensated Rearfoot Varus exists with a normal or neutral forefoot alignment. This foot-type is congenitally a partially unstable foot and is often diagnosed in children as developmental flat foot. Make no mistake, if you think that this child will "out-grow the deformity," just ask their biological parents, grandparents and older siblings to take off their shoes and socks. If family members demonstrate similar foot characteristics, chances are that this child is not going to develop an arch. During gait, this foot begins to pronate at the subtalar joint in contact phase, and continues to pronate throughout midstance. In propulsion, the 1st ray will plantarflex to load the medial column of the foot and allow the foot to re-supinate.

The **F Quad Foot Type** is commonly referred to as a Pes Planovalgus foot deformity because of its very poor alignment to the floor. This is a true "flat foot." The condition occurs when a Compensated Rearfoot Varus is coupled with a large Flexible Forefoot Varus (also called Forefoot Supinatus).This foot type is the most hypermobile or flexible of the foot-types. This hypermobility leads to great instability throughout the foot and ankle, and can be prevalent throughout the body. These feet look "very flat" at an early age and can only worsen into adulthood. This severe instability also makes it difficult to develop and maintain core strength throughout

FIGURE 2: Typical foot type in those with Down syndrome pictured left to right: The D foot type (neutral forefoot with compensated rearfoot) The F foot type (rigid forefoot varus with compensated rearfoot) courtesy of www.whatsmyfoottype.com

the legs and trunk. Muscles need to work "overtime" to do the same job as someone with better functioning feet, drastically increasing energy expenditure. This foot-type causes a lot of damage to the forefoot during propulsion. In addition to transverse metatarsal arch reversal, don't be surprised to see hammertoes, hallux abductovalgus deformity, functional hallux limitus, and painful corns and calluses.

Effects of the D & F foot (of those with Down syndrome) on the Kinetic Chain

Let's start with the knee. Len Leshin, MD, FAAP writes, "Instability of the patella (kneecap) has been estimated to occur in close to 20 percent of people with DS. The majority of cases of instability present only as kneecaps that can be moved further to the outside than the normal kneecap (subluxation); however, some people can have their kneecaps completely move out of position (dislocation), and some may even have a hard time getting it back into the right position. Mild subluxation of the kneecap is not associated with pain, but dislocation may be painful. While people with instability of the patella are able to walk, there is often a decreased range of motion of the knee, with an accompanying change in gait. The longer that nothing is done for the instability, the worse the condition will get over time. Orthoses (special braces) may be useful for mild cases, but severe cases require surgical correction." [1]

Next up the chain comes the hip. Leshin continues, "Five to eight percent of children with DS will develop abnormalities of the hip. The most common condition is dislocation of the hip, which is also called subluxation. In this condition, the head of the thigh bone (the femur) moves out of the socket formed by the pelvis (the acetabulum). This dislocation may or may not be associated with malformation of the acetabulum. The dislocation appears to be due to a combination of laxity of the connective tissue that normally keeps the hip together along with the low muscle tone found in DS. Interestingly, hip subluxation in children with Down syndrome is hardly ever found at birth but instead is most common between the ages of 3 and 13 years. The most common sign is a limp, and pain may or may not be present. Treatment will often start with immobilization of the hip with a cast. Many children with DS will require surgical correction, however."[1]

And finally we hit the back. Leshin adds, "Another condition associated with the spine in Down syndrome is scoliosis, which is the curvature of the spine to the side. While it appears to be more common in people with DS, the exact incidence isn't known.…Treatment of scoliosis remains the same as in other children, with bracing being the initial therapy, followed by surgical intervention if necessary."[1]

The overall plan

Orthoses need to be specifically designed to improve coordination, balance, pain, posture, and strength, and to aid in the development of a more stable and functional gait. These orthoses should be comprised of a deep heel cup, a medial heel skive, and high medial and lateral sidewall flanges. (FIGURE 3) Control of the subtalar joint is paramount. Often kids are over-braced with AFO's due to lack of foot control. By providing adequate foot control, SMO's and AFO's are often times not necessary. I find many children who are "over-braced" lack necessary joint movements and muscle development vital for normal growth and maturity.

Complementary solutions to Early Biomechanical Support

Physical Therapy progress typically associated with Down syndrome motor development is slow; and instead of walking by 12 to 14 months as other children do, children with Down syndrome usually learn to walk between 15 to 36 months. Specific physical therapy recommendations to consider, along with inserts/orthotics/SMO's, include: "Strengthening of lower extremity musculature (hips, knees, ankles, and feet) aimed at improving push off and augmenting support of the knee joint. Heel cord stretching with the heel in neutral alignment when limited passive range of motion exists. Lastly, Dynamic balance activities, such as running or descending stairs, which encourage the child to shift their weight during late swing phase rather than waiting until heel contact." [8] These are very good recommendations. I, along with many therapists in my area of practice, am seeing that when orthotic inserts are prescribed along with physical therapy, the improvement really sticks and builds. I see children in therapy all the time that have these everted/flat feet who just either never or too slowly build on strength absent there orthotics. Building better foundation helps those muscles move along faster.

FIGURE 3: A functional UCB type orthotic, with a high medial and lateral sidewall flanges, such as littleSTEPS, combined with supportive footwear, can be highly effective for the typically flexible foot of a young child with Down Syndrome.

Getting the Ds patient to make an appointment

But to treat a Down syndrome patient, you have to see them. That is where the education piece is so critical. In many of our communities, we have Early Intervention services for babies born prematurely or with medical concerns. This can be the place where an initial referral can originate. When an EI therapist understands the importance of the feet and biomechanics in the development of any child, she/he can screen for this. With early intervention, Down syndrome patients can have a better outcome in meeting their developmental milestones and lessening their risks of Alzheimer's and obesity.

In Summary

So what can you do to help? As podiatrists, we are in the unique position of being trusted medical professionals of the lower extremity and its effects on the kinetic chain. This gives us the ability to get out and educate, educate, educate. Preparing the community of people who work with the Down syndrome patients is the key to getting these clients proper foot care early in life in order to allow them a better chance at a long, healthy, active existence. "Treatment of painful feet in patients with Down syndrome is imperative because foot pain leads to relative immobilization and immobile retarded adults do not remain long in the community."[9] My goal as a practitioner and someone who recognizes the progression of foot types is preventing pain by knowing how to deal with it before it happens, coupled with improving overall biomechanical strength and structure. No matter a child's medical diagnosis, it is important to educate parents and their children what their "foot type" is, and what that may bring them during their adult years. Please feel free to reference my websites www.whatsmyfoottype.com and http://www.decaropodiatry.com for additional information regarding my practice and its methodologies.

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