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Equino-plano-valgus foot in cerebral palsy – clinical principles and surgical techniques review (world perspective). Report from the 5th edition of the Transatlantic Orthopedic Surgery Webinar 2023

Stopa końsko-płasko-koślawa w mózgowym porażeniu dziecięcym – przegląd zasad klinicznych i technik chirurgicznych (perspektywa światowa). Raport z 5. edycji Transatlantic Orthopedic Surgery Webinar 2023

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REPORT

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Abstract

Introduction. The fifth edition of the Transatlantic Orthopedic Surgery Webinar 2023 occurred on December 4, 2023. The webinar's main topic was treating equino-plano-valgus foot in children with cerebral palsy (CP). The event included speakers from Austria, Australia, China, India, Canada, Germany, Poland, Sweden, Turkey, the USA and the UK.
Results. The first general session presented epidemiology, biomechanics, muscle function, equino-plano-valgus foot prevention options, and the Silverskiöld test in clinical assessment. It also discussed the principles of deformation treatment, options for orthotic treatment, and pathology treatment in adults suffering from CP. The surgical sessions presented comprehensive surgical techniques for the treatment of clubfoot equinus: sliding calcaneal osteotomy, lateral column lengthening with talonavicular arthrodesis, use of an expandable cage for the lateral column lengthening, double arthrodesis with the transfer of the peroneal muscles, percutaneous soft tissue release with/without arthroereisis, lateral column lengthening with arthroereisis, Grice procedure with talonavicular arthrodesis, lateral column lengthening with medial cuneiform bone plantarflexion osteotomy, lateral column lengthening with duplication of the talonavicular capsule, talonavicular and calcaneocuboid arthrodesis, transfer of the tibialis anterior muscle to the peroneal tertius muscle. The second general session presented methods of assessing the results of clubfoot treatment and postoperative rehabilitation protocols involving upright positioning and walking.
Conclusion. The most important conclusions from the event are: clinical assessment and understanding the pathophysiology of the defect is crucial for its proper treatment; non-surgical treatment is recommended under the age of 6; between the ages of 6 and 14, surgical methods that preserve joint function predominate; after the age of 14 a large percentage of patients require performing joint arthrodesis. Nevertheless, arthrodesis should be avoided to correct flexible deformities and to treat patients with high functional requirements. The webinar audience included 583 people from 50 countries. Most participants came from Poland, Spain, Turkey, and Great Britain.
Key words: cerebral palsy, equino-plano-valgus foot, plano-valgus foot, lever-arm deformities of lower limbs.

Streszczenie

Wstęp. Piąta edycja Transatlantic Orthopedic Surgery Webinar 2023 miała miejsce 4 grudnia 2023 roku. Tematem przewodnim webinarium było leczenie stóp końsko-płasko-koślawych u dzieci z mózgowym porażeniem dziecięcym (mpd). W wydarzeniu brali udział prelegenci z Austrii, Australii, Chin, Indii, Kanady, Niemiec, Polski, Szwecji, Turcji, USA i Wielkiej Brytanii.
Wyniki. W pierwszej sesji ogólnej przedstawiono epidemiologię, biomechanikę, funkcję mięśni oraz zasady zapobiegania stopie końsko-płasko-koślawej, zastosowanie testu Silverskiöld w ocenie klinicznej. Omówiono również zasady leczenia deformacji, opcje zaopatrzenia ortotycznego oraz zasady leczenia patologii u osób dorosłych chorujących na mpd. W sesjach chirurgicznych przedstawiono kompleksowo techniki

operacyjne leczenia stopy końsko-płasko-koślawej: osteotomię medializującą guz piętowy, osteotomię wydłużającą boczny brzeg stopy z artrodezą skokowo-łódkowatą, wykorzystanie rozszerzalnych implantów (cage) do wydłużenie bocznego brzegu stopy, podwójną artrodezę z przeniesieniem mięśni strzałkowych, przezskórną miofasciotomię z/bez artroerezy, wydłużenie bocznego brzegu stopy z artroerezą, procedurę wg Grice'a z artrodezą skokowo-łódkową, wydłużenie bocznego brzegu stopy z osteotomią kości klinowatej przyśrodkowej wg Cottona, wydłużenie bocznego brzegu stopy z duplikaturą stawu skokowo-łódkowego, artrodezę skokowo-łódkowatą oraz piętowo-sześcienną, transfer mięśnia piszczelowego przedniego na mięsień strzałkowy trzeci. W drugiej sesji ogólnej przedstawiono sposoby oceny wyników leczenia stopy końsko-płasko-koślawej oraz protokoły rehabilitacji pooperacyjnej zakładające pionizację i chodzenie.
Wnioski. Najważniejsze wnioski płynące z wydarzenia to: ocena kliniczna oraz zrozumienie patofizjologii wady jest kluczowe dla jej prawidłowego leczenia, poniżej 6. roku życia rekomenduje się leczenie nieoperacyjne, pomiędzy 6. a 14. rokiem życia przeważają metody chirurgiczne oszczędzające funkcję stawów, po 14. roku życia duża grupa pacjentów wymaga wykonania artrodez stawów, jednak powinno się ich unikać w korektywnych deformacjach oraz u pacjentów z wysokimi wymaganiami funkcjonalnymi. Audytorium webinarium liczyło 583 osoby z 50 krajów. Największa liczba uczestników pochodziła z Polski, Hiszpanii, Turcji i Wielkiej Brytanii..

Słowa kluczowe: mózgowe porażenie dziecięce, stopa końsko-płasko-koślawa, stopa płasko-koślawa, deformacje dźwigniowozależne kończyn dolnych.

Introduction

The Transatlantic Orthopedic Surgery webinar is an annual worldwide event dedicated to the pathophysiology, diagnosis, and treatment of selected orthopedic issues in developmental neuro-orthopedics, mainly cerebral palsy (CP). The event is addressed to orthopedic surgeons, neurologists, rehabilitation specialists, and physiotherapists dealing with functional impairments in CP.

The fifth edition of the Transatlantic Orthopedic Surgery Webinar 2023 took place on December 4th, 2023, under the auspices of the European Academy of Childhood Disability (EACD). In addition, as a combined event, international organizations such as the American Academy of Cerebral Palsy and Developmental Disability (AACPDM), the European Pediatric Orthopaedic Society (EPOS), and the Pediatric Orthopedic Society of North America (POSNA) also participated in the event. The Webinar includes a theoretical and surgical workshop part with an extensive summary of a clinical consensus discussion.

The Webinar's central theme was equino-plano-valgus foot in cerebral palsy. It was directed by Marek Jóźwiak and moderated by Elisabet Rodby-Bousqet, Micheal Wade Shrader, Peter Bernius, Bartosz Musialak, and Łukasz Woźniak. The Orthopediatrics held the industry support.

During this Webinar, multiple recorded surgeries were broadcasted from ten different operating theatres in München, Germany; Istanbul, Turkey; Mumbai, India; Shenzhen, China; Melbourne, Australia; San Diego, California; Wilmington, Delaware; Saint Paul, Minnesota; Vienna, Austria, and Poznan, Poland. Surgeries covered the broad spectrum of surgical techniques for treating equino-plano-valgus foot in cerebral palsy.

Through this Webinar, participants had a unique opportunity to explore equino-plano-valgus foot pathophysiology, epidemiology, orthotic treatment, and foot surgery with particular attention to the main indications and contraindications for the use of the techniques and learn how to avoid possible pitfalls during the surgery. The experts in neuropediatric orthopedic surgery had a chance to share their experiences and surgery tricks among participants worldwide including low-income countries such as Columbia, Malesia, Sri Lanka, Ukraine, and Uzbekistan.

The organizing committee of the Webinar included:

- Marek Jóźwiak
- Peter Bernius
- Michael Wade Shrader
- Elisabet Rodby-Bousquet
- Bartosz Musielak
- Łukasz Woźniak

While the webinar faculty included:

- Marek Jóźwiak, Dega Hospital at Poznan University of Medical Sciences, Poznan, Poland – Chair of the Faculty
- Peter Bernius, Schön Clinic, München, Germany
- Hank Chambers, Rady Children's Hospital, San Diego, CA, USA
- Lin Feng, Department of Pediatric Orthopedics, Hong Kong University, Shenzhen Hospital, China
- Martin Gough, GB, Evelina London Children's Hospital, Guy's & St Thomas' NHS Foundation Trust, London, UK
- Kerr Graham, The Royal Children's Hospital, Melbourne, Australia
- Muharrem Inan, Ortopediatri Pediatric Orthopedic Academy, Istanbul, Turkey
- Ashok Johari, Children's Orthopaedic Centre, Mumbai, India
- Alexander Krebs, Orthopaedic Hospital Speising, Vienna, Austria
- Simon Lalor, The Royal Children's Hospital, Melbourne, Australia
- Unni Narayanan, SickKids Hospital, Toronto, Canada
- Tom Novacheck, Gillette Children's Hospital, Saint Paul, MN, USA
- Elisabet Rodby-Bousquet, Orthopaedic Department, Lund University, Lund, Sweden (EACD Education Committee)
- Michael Wade Shrader, Nemours/Alfred I. duPont Hospital for Children, Wilmington, DE, USA

GENERAL SESSION 1

Epidemiology of the equino-plano-valgus foot in children and adults GMFCS I-III

Elisabet Rodby-Bousquet

Cross-sectional data of valgus and equinus from the Swedish Register of Cerebral Palsy Cross-Section covers 3119 children (mean age 10±4.8) and 1839 adults (mean age 28.5±11.6). In Gross Motor Function Classification System (GMFCS) [1] I-III, 19% children had unilateral valgus (21% GMFCS I, 19% GMFCS II, 10% GMFCS III), 36% bilateral valgus (25% GMFCS I, 49% GMFCS II, 75% GMFCS III). 23% adults had unilateral valgus (23% GMFCS I, 27% GMFCS II, 18% GMFCS III), 39% bilateral valgus (24% GMFCS I, 45% GMFCS II, 66% GMFCS III). Bilateral valgus is most common at 1-3 years (58%).

9% of children had unilateral equinus defined as less than -5 deg of dorsal flexion (8% GMFCS I, 11% GMFCS II, 10% GMFCS III), 2% had bilateral equinus (0,4% GMFCS I, 4% GMFCS II, 6% GMFCS III). 17% of adults had unilateral equinus (13% GMFCS I, 22% GMFCS II, 17% GMFCS III), and 5% bilateral equinus (1% GMFCS I, 5% GMFCS II, 12% GMFCS III). Equinus is twice as common in adults as in children.

5% of children had unilateral equinus defined as less than -10 deg of dorsal flexion that is considered a more relevant threshold when indicating the need for surgery (4% GMFCS I, 8% GMFCS II, 7% GMFCS III), 1% had bilateral equinus (0,2% GMFCS I, 2% GMFCS II, 4% GMFCS III). 11% of adults had unilateral equinus (8% GMFCS I, 12% GMFCS II, 14% GMFCS III), and 2% bilateral equinus (1% GMFCS I, 2% GMFCS II, 4% GMFCS III).

Equino-plano-valgus foot biomechanics

Tom Novacheck

The functions of pronation are to unlock the joints of the foot, adapt to allow function on uneven surfaces, and facilitate lower extremity shock absorption (function of the foot during first and second rockers). In supination, the foot is more rigid, providing a tough lever for the push-off (function during the third rocker).

The subtalar neutral position, according to Root, is a position from which the subtalar joint might be maximally pronated or supinated [2]. Therefore, the subtalar joint functions optimally in this alignment. According to another definition, it is the position of the subtalar joint where it is neither pronated nor supinated. To determine the neutral position of the subtalar joint, one needs to palpate the articulation between the head of the talus and the navicular bone. In pronation, the head of the talus will be felt medially behind the tuberosity of the navicular. With supination, the head of the talus will disappear medially and become prominent over the lateral side of the talus. To determine the foot position, one should achieve the neutral position of the talonavicular joint (when neither the medial nor lateral side of the talar head is more prominent). In this position, the gentle dorsiflexion force should be applied to the metatarsal heads of the IV and V metatarsal bones (only until the resistance is felt).

The foot functions as a tripod. Three major pressure points are the calcaneal tuberosity, the fifth metatarsal head, and the first metatarsal head. In CP in a non-weight bearing position, the hindfoot typically is in the neutral position, but the forefoot is in the varus position. When this tripod goes on the floor, the hindfoot everts, the talus head goes down and in, and the forefoot abducts. In summary, the equino-plano-valgus foot in CP has forefoot varus, hypermobile collapsed midfoot, frequently associated with the contracture of the gastrocnemius (but not the soleus) muscle. The presenter sees no relationship between equino-plano-valgus foot and early weight-bearing (WB).

Muscles function in equino-plano-valgus foot

Martin Gough

Muscles can pull but cannot push. They control joint rotation by acceleration (generating power) or deceleration (absorbing power). This ability is limited in muscles in CP by mechanical, morphological, metabolic, and maturational changes. Mechanically, muscles in cerebral palsy are stiffer. After botulinum toxin injection, the stiffness is less pronounced [3]. Morphologically, they are smaller– distal muscles that control the foot are particularly affected [4]. Diminished muscle volume starts early, at the age of 10 months. This divergence is noticeable mainly in GMFCS III and IV (compared to GMFCS I and II). Metabolically, mitochondria have impaired function in children with CP [5]. Each metabolical mitochondrial complex is less effective in CP, producing less energy for muscle development and function. Stem cells are also reduced in children with CP [6].

Prevention of equino-plano-valgus foot

Martin Gough

The foot is not just a structure but an integrated and dynamic system that changes over time. In the foot, peak muscle growth precedes peak bone growth in males and females.

Altered muscle growth is associated with modified bone and joint development in children with CP, which is most commonly seen in spastic hips. Consider the valgus foot deformity as a dysplastic foot related to altered growth and development of the foot. Altered foot bone development may be caused by impaired muscle growth and function interaction and the pattern of extrinsic load to the foot. It may explain the lack of evidence of correction of equino-plano-valgus foot with orthoses. Orthoses provide support but have a limited capability of correcting bone growth patterns. To prevent the equino-plano-valgus deformity, we should change the muscle development with botulinum toxin injections and proper shoe wear.

The Silfverskiöld test for equino-valgus assessment

Marek Jóźwiak

The test was described 100 years ago [7]. We should use it for better understanding and clinical interpretation of the equino-plano-valgus foot. It helps to state the surgical indication for uni- and bilateral deformity, botulinum toxin treatment, and orthotic treatment. In the author's experience, it is more advantageous for unilateral deformities. The test has three forms: classical (in supine foot position), modified (in prone position), and the dynamic range of dorsal flexion with stretching resistance assessment according to the Tardieu catch phenomenon. For equino-plano-valgus foot deformity, the Silfverskiöld test should be performed in a two-hand technique to provide the valgus correction and assess the range of motion. The test can be used in general anesthesia just before the surgery. The clinical signs that may lead to Silfverskiöld misinterpretation are round forefoot, valgus hindfoot, narrow and hypertrophic heel, knee join recurvation, and hip flexion contraction.

The valgus foot in cerebral palsy: what's the dose?

Kerr Graham

"Doses" available for equino-plano-valgus foot: ankle-foot orthoses, orthoses+Botox, arthroereisis, joint sparing surgery [calcaneal lengthening osteotomy (CLO)], fusion surgery [talonavicular (TN), subtalar (ST)], salvage [corrective triple arthrodesis (TA), pantalar fusion]. Decision-making is based on the patient's age, GMFCS, severity of the deformity, and sagittal gait pattern. Before the age of 6, orthoses only are preferred. At the age of 6-8 years, we delay the surgery when possible, and we may consider the arthroereisis. At the age of 8-12 years, reconstructive surgery, and in adolescents older than 12, reconstructive or salvage (in severe deformities) procedures are considered. In GMFCS I, orthoses or CLO are considered; in GMFCS II, usually CLO is performed; in revision cases with TN fusion; in GMFCS III, usually fusion (TN or ST), there is a very high failure rate of CLO in GMFCS III, in GMFCS IV always fusion is necessary.

In mild deformities, use AFO during growth, then consider CLO; in moderate deformities at the age older than six years CLO; in severe deformities and the age older than eight years fusion or CLO; in very severe deformities or recurrences after CLO: ST fusion, TN fusion, TA. In equinus gait: correct equinus+CLO; in jump gait: single-event multilevel surgery (SEMLS) with CLO; in apparent equinus and crouch gait: SEMLS+CLO or fusion. Using ankle-foot orthosis (AFO) in young children is better than undergoing surgery too early. Many children have a combination of pes equino-plano-valgus and external tibia rotation, and they need foot correction, internal supra – malleolar tibial rotation, and solid AFO after the surgery. When the distal tibia is internally rotated, we obtain the medial translation of the distal tibial fragment, contributing to the correction of the valgus foot deformity. There is a need to put the pes equino-plano-valgus correction in the context of the whole limb deformity. One can start the orthotic treatment with hinge-AFO as early as 12-24 months of age. After the surgery (especially fusions), the author prefers solid AFO for 6-12 months. Then, in most cases, these are changed for hinged AFO, then leaf-springs and insoles, up to leaving the patient orthosis-free.

Orthosis use in the equino-plano-valgus foot

Simon Lalor

The musculoskeletal system pathologies can be divided into four different stages:

1) Stage 1: hypertonia: the abnormal postures are dynamic; the hinged AFO is indicated that allows for more than 5 degrees of dorsiflexion and stabilizes the subtalar joint in a neutral position
2) Stage 2: contracture: fixed shortening of one or more muscle-tendon units; early in this stage, the hinged AFO is indicated that allows for more than 5 degrees of dorsiflexion and stabilizes the subtalar joint in a neutral position; late, as contraction progress the solid AFO
3) Stage 3: bone and joint deformities (torsional deformities may be present): in this stage, equino-plano-valgus foot is common, solid AFO is indicated
4) Stage 4: decompensation: the optimal restoration of bone and joint function is impossible, may consider

solid AFO if the risk of pressure injury is less than the potential functional benefits; in this stage, the concept of AFO holidays/retirement should be considered,

Orthotic design to support surgery:
After distal tibial rotational osteotomy, the plate should be rotated towards the frontal alignment, and the screws should be as flat as possible to create the skin/orthosis interference that can accept the force from the medial crus aspect (not to irritate the skin between the implant and the orthosis).

There might be a conflict in CLO between the implants used for stabilization or the scar and orthosis. The pre-planning between the orthotic and surgeon is crucial to ensure the surface can accept the force created by the orthosis.

Hallux valgus and “CP bunions” are usually corrected by first metatarsophalangeal joint (MTPJ) fusion. The orthosis aims to prevent the dorsiflexion in I MTPJ to allow fusion. It can be obtained by extension of the medial and lateral metatarsal head trim lines distal to metatarsal heads, inserting carbon fiber foot plate for added stiffness, or forefoot rocker sole on shoes.

Modern AFO manufacturing is based on Finite Element Analysis to inform the design of 3D-printed AFOs. It is the computerized method to predict how a product reacts to real-world forces. We can examine the mechanical behavior of AFO in automatic simulated gait. It permits testing material properties and design before fitting AFO to the patient and using machine learning to inform design for 3D printing. To make the solid AFO the deformation of up to 2 degrees has no clinical effect on proximal joints. The generative design is applied to apply the right amount of pressure in the right spot in AFOs, the amount of corrective force is matched to the specific area, and asymmetric trim lines and variable thickness are used. The problem with AFOs is the lack of plantar flexion at the first rocker, which may produce an excessive knee flexion moment. The lattice structure is inserted into the heel of the AFO to minimize this effect. It allows console compression during the weight acceptance, which influences the speed and direction of the 1st rocker progression. The AFOs should be accommodated to the residual equinus of the foot. Any attempt to force the foot position results in pressure ulcers and AFO intolerance.

Principles of surgical treatment of equino-plano-valgus foot

Peter Bernius

In the equino-plano-valgus foot, muscle shortening instability of the talo-calcaneal joint, or fixed deformity is present. The principles of equino-plano-valgus foot treatment depend on specific deformity characteristics, the patient’s age, overall health, and underlying causes. The treatment involves the combination of soft tissues and bony procedures. Pre-operative assessment may include X-rays, deep-vein thrombosis (DVT) scans, and magnetic resonance imaging (MRI). Treatment involves cooperation between podiatrists, physical therapists, orthopedic surgeons, and other health care professionals. The soft tissue procedure consists of the tendon Achilles or peroneus brevis tendon lengthening and intramuscular lengthening or tendon transfer. Realignment procedures of flatfoot and hindfoot valgus include:

- medial calcaneal sliding (MCS) osteotomy
- lateral column lengthening (LCL) osteotomies.
- distal tibia variation osteotomy
- distal tibia derotation osteotomy

The decision between arthrodesis or joint preserving surgery depends on the patient’s age, the severity of arthritis, and functional demands. Artroereisis is considered a joint-preserving surgery with multiple implants available. Metatarsal osteotomies or metatarsal fusions might be used for forefoot correction. Postoperative care includes immobilization, physical therapy, orthotic devices, or custom forefoot insoles. Rehabilitation and physical therapy are essential to restore strength, flexibility, and muscle function. Patient education includes the nature of the deformity, the goals of the surgery, and the importance of compliance with postoperative care and rehabilitation. Long-term follow-up is crucial for monitoring the patient’s progress, addressing complications, and maintaining corrected foot alignment. The procedure should be tailored to each patient individually.

Equino-plano-valgus foot in adults

Hank Chambers

Equino-plano-valgus foot in adults is much stiffer than in children, and it worsens with increasing GMFCS levels. It is often associated with hallux valgus and sometimes with dorsal bunion. Bony changes can occur with enlarged navicular bone and an inability to reduce the midfoot joints. Arthritic changes may be present. Treatment options in adults are soft tissue lengthening, MCS osteotomy, LCL, ST arthrodesis, TN arthrodesis, and TA. As they become adults, many children develop valgus deformity of the ankle joint, which must be addressed with rotational osteotomies. The simple way to perform the ST arthrodesis is to put the screw from the talus to the calcaneus. You can set another screw from the calcaneus to the talus. Evan’s LCL is less effective in adults as the foot becomes stiffer. TN fusion might be obtained by two retrograde screws stabilization. It is particularly indicated for arthritis of the

TN joint or where foot position cannot fully corrected. The last resort treatment is a TA. It can worsen the arthritis in the ankle joint and midfoot joints. Despite this, it is often the best solution for adults with CP.

According to the author of this presentation, the most common surgery done in adults is the correction of the dorsal bunion and hallux valgus deformity by fusion.

In most adults, GMFCS IV and V, we must fit the proper shoes to protect feet and keep them warm. Insoles make little difference.

SURGERY SESSION 1

Sliding calcaneal osteotomy and later column lengthening +/- talonavicular arthrodesis

Hank Chambers

Soft tissue procedures are crucial. The first incision is at the postero-lateral surface of the tibia between the 1/3 distal and 1/3 medial. The author often performs the Strayer or Vulipus procedure to elongate the triceps sure and the peroneus brevis lengthening at the musculotendinous junction. The second incision is at the lateral portion of the foot below the lateral malleolus. Retracting the peroneal tendons and sural nerve is crucial to performing the MCS. The lateral cortex should be cut with the osteotome or the saw. The author prefers the osteotome over the saw to complete the osteotomy at the medial side. When you don't feel comfortable getting to the other side with the osteotomy, you can use the lamina spreader for better visualization and complete the osteotomy with Kerrison Rongeur. The author usually moves the distal fragment medially by 1 cm. If further displacement is required, there may be problems with the skin on the medial and lateral sides. In the next step, the author does the cuboid osteotomy. To do it, you retract the peroneal tendons planetary. The author prefers to use the saw over the osteotome not to crush the bone, which is often osteoporotic. You go with the osteotomy up to the medial side (the hinge is on the medial side). Then, one performs the incision on the medial foot side. The plantar wedge from the medial cuneiform with the base pointing plantar is removed, and we close the osteotomy. The retrograde transcutaneous Kirschner wire stabilizes the osteotomy site. The TN reefing (advance the joint capsule) may be added on the medial side. In older individuals, TN arthrodesis is indicated. Two retrograde cannulated screws may obtain the stabilization of the arthrodesis. Next, the site of the cuboid osteotomy is filled with the graft to get LCL. The bony graft might be obtained from the cuneiform, but it is often too small and weak, so allografts are often used with good incorporation. Postoperative management: short leg cast for six weeks total; at third weeks, pins are removed, AFO is molded (solid AFO for 3-6 months, then the posterior leaf AFO), and the WB cast is applied. WB is allowed after six weeks if bones do not heal enough in the third week. The optimal age for this procedure is 7 to 13-14 years.

Use of an expandible cage for foot lateral column lengthening

Muharrem Inan

When the Coleman test is positive in children older than eight years, the author considers the hindfoot deformity as dynamic and qualifies the patient for LCL. If there was any forefoot supination, he performed a medial cuneiform osteotomy. If the Coleman test is negative, the hindfoot deformity is qualified as static, and the patient is scheduled for LCL with MCS or ST arthrodesis. We combine this procedure with Achilloplasty. If the surgery fails, the speaker qualifies the patient for the TA. The author uses an expandable implant instead of a bone graft to elongate the anterior process of the calcaneus. The different sizes of the implant are available (small, medium, large).

The approach is lateral, with a length of 2-3 cm. The removal of soft tissues from sinus tarsi is performed. The surgeon has to protect the sural nerve. The Hohman retractor is used for the protection of peroneal tendons. The osteotomy is started with the saw and completed with the osteotomy to protect the neurovascular bundle. The unique handle is used to fix the implant. By turning the handle, the implant might be expanded. The osteotomy side is distracted by the lamina spreader. The implant is placed at the osteotomy site. The system should be inside the bone. You can check the extension of the bone expansion at the image intensifier. The wound is closed routinely with interrupted sutures. The short leg cast is applied. Postoperatively, the patient is encouraged to walk on the 3rd day. After six weeks, the cast is removed, and the solid AFO is applied. The solid AFO is applied after six weeks. The physiotherapy aims to strengthen the tibialis anterior muscle. During the year after the surgery, The University of California-Berkeley Lab (UCBL) splint or medial arch-reinforced orthopedic shoes can be used for walking. The author has 11 years of experience with this method, with over 300 cases. The superiority is the lack of nonunions and no iliac crest mortality. But there is no proven superiority to other techniques (with bony grafts). The suitable candidates for this procedure are children older than eight years.

Double arthrodesis with peroneal tendon transfer

Alexander Krebs

The presenter's indication for this surgery is flexible planovalgus foot deformity. The first incision is over the calcaneus on the lateral foot aspect, and the second is at the distal 1/3 of the crus over the peroneal tendons. Separating the peroneus longus muscle is crucial in the distal and proximal approach (when we pull the tendon, the foot's first ray moves). The tenodesis of peroneus longus and brevis tendons is performed distally. The author cuts off the peroneal longus tendon proximally to the tenodesis at the level of the calcaneus and transfers the tendon proximally through the proximal approach. On the medial side, we perform two approaches: one at the level of distal 1/3 of the tibia for tendon transfer and the second on the medial foot site over the talonavicular joint. The tunnel in soft tissues is prepared just behind the tibia and fibula. We start preparation between the tibialis posterior sheath and tibial bone and direct the approach laterally behind the fibula. The peroneous longus tendon is transferred medially through the tunnel. The next step is to remove the cartilage from the subtalar joint from the lateral approach. The author prefers to do it by drilling. Next, the preparation of the talonavicular joint is performed by capsulotomy. We enter the tibialis posterior sheath distally to proximally with the holed K wire and transfer the peroneus longus tendon from the crus level distally inside the tibialis posterior sheath.

Now, the presenter removes the cartilage from the talonavicular joint with the curved chisel. The author drills holes at the articular suffices to get better healing. Two Kirschner wires and cannulated screws are inserted percutaneously from the plantar aspect of the calcaneus crossing the subtalar joint with X-ray AP and lateral view control of the implant position. Then the two Kirschner wires and cannulated screws are used for stabilization of the talonavicular arthrodesis (X-ray control). Additionally, the staple is used for talonavicular joint stabilization. Then, one creates two perforations in the tibialis posterior tendon close to each other and pulls the peroneus longus tendon through these (Pulvertaft technique). The tendons are sutured together, and additionally, the distal part of the peroneus longus is sutured to the talonavicular capsule. The optimal age for the talonavicular arthrodesis is older than 13-14 years.

Percutaneous soft tissue release and arthoereisis

Peter Bernius

The group from Munchen considers the fascial tightness in CP to be present very early; some papers suggest that it even occurs after birth. The causative factor is movement restriction in this patient group. That is why they start soft tissue procedures very early. The presenter showed the case of the five-year-old child with heal in equinus, thigh peroneus brevis, tibialis anterior muscles, and flattened medial foot arch. The midfoot break is severe in standing foot X-ray, and the heel is up. The first stage is to do the gastrocnemius-soleus release in the mid-muscle belly to obtain the downward movement of the heel. Next, the tibialis anterior is released at the muscle belly level to get the forefoot's plantar flexion. The peroneus brevis is addressed through the lateral approach at the heel level (first, the author goes with the knife from the plantar aspect to the dorsal, then from dorsal to plantar to release the fascia of the abductor digiti minimi muscle). It allows us to obtain the full forefoot adduction. After the procedure, the author immobilizes the extremity in a removable Soft-Cast interrupted by exercises to let the soft tissues heal optimally. The patient is prescribed elastic insoles for walking. In children older than 5-6 years author adds arthroereisis to this procedure. We find the proper spot for the incision under the X-ray amplifier. The presenter does the soft tissue dissection of the lower ankle joint with scissors. Then, the release of the ligaments between the talus and calcaneus is performed. The Kirschner wire is introduced into the subtalar space. The wire should come out directly behind the medial malleolus at the foot medial aspect. Then, the probes are consequently inserted over the Kirschner with a starting diameter of 5 mm. When the probe is inserted, the author tests whether the hypermobility in the subtalar joint is reduced with enough movement still present (needs experience). The right side of the probe is selected, and an implant of the same size is inserted over the Kirschner wire. The X-ray controls the implant position. A wound suture is performed (ligaments are sutured to prevent the implant migration). This procedure does not address the forefoot supination, which is handled by the postoperative treatment (4-week removable Soft-Cast splints followed by insoles). The author does not observe any foot stiffness after this procedure. 1-2% of children suffer from pain after the procedure, and the implant needs to be removed. The development of the peroneal muscle spasticity is one of the causes of the pain. The correction is to be maintained when the implant was inserted for more than a year and had to be removed. The excellent age for soft tissue procedure is as early as 2-3 years (in children who cannot fully WB). With this procedure, the author aims to prevent using stiff orthoses like AFOs (only insoles). The author uses botulinum toxin just for testing before the selective dorsal rhizotomy; he prefers to perform an early soft tissue procedure because of the muscle stiffness. Stretching is started the day after the surgery to make the scar elastic and not stiff again. Muscle power increases after the surgery, based on the measurements in the gait lab.

Foot lateral column lengthening and arthroereisis

Ashok Johari

The author presented the technique for correcting the planovalgus foot with severe hindfoot valgus, a drop of the talus, and a high talo-2nd metatarsal angle in dystonic CP patients.

The first incision is above the sinus tarsi, and the dissection of ligaments between the talus and calcaneus is performed with sharp scissors. The proper implant size is chosen and inserted analogously, like in the technique presented by Peter Bernius. LCL is performed from the same incision. The sural nerve is localized and protected. Then, the peroneal sheath is incised, and peroneal muscles are protected. The calcaneal periosteum is cut and lifted off. Two Kirschner wires are inserted retrograde to stabilize the calcaneocuboid joint. The calcaneal anterior process osteotomy is performed and distracted. The bony graft harvested from the iliac crest is impacted into the osteotomy site. The Kirschner wires are passed further to stabilize the osteotomy site with the graft. When the peroneus brevis is tight, a partial tenotomy is performed. Would is closed in the typical way. The Strayer procedure is performed when the triceps surea is tight. If the forefoot supination is present, the open-wedge cuneiform osteotomy is needed to push the forefoot down. The graft is impacted to the osteotomy site in a typical manner and stabilized transcutaneously by the Kirschner wire. In GMFCS II, we would like to avoid the talonavicular fusion. The results of artroereisis are good in neurogenic and idiopathic flat feet. The upper limit for artroereisis is the talo-II metatarsal angle of 40 degrees. When this value is excited, it should be combined with other procedures. The long-term outcome is reasonably good, according to the literature. The papers show the good remodeling between the talus and calcaneus after artroereisis [8].

ST and TN fusion for severe pes valgus in CP: general principles

Kerr Graham

Indication for the ST and TN fusion: severe pes valgus, GMFCS III, adolescents, crouch gait. The fusion reduces foot ROM in all the triple joints, but the "stiff" plantigrade foot lever may be advantageous. ST and TN fusion can correct the deformity in the hindfoot, midfoot, and forefoot via "segmental linkages." There are many techniques of ST fusion, and all require bone graft use. TN fusion does not require bone graft but is more demanding in preparing the joint and acquiring stable fixation and sound fusion. TN fusion permits correction in three planes: adduction, flexion, and rotation.

For ST fusion (modified Grice procedure), the author uses an Ollier approach and carefully detaches the extensor digitorum brevis to cover the graft later. The author uses the equipment from the I metatarsal-phalangeal fusion set. He uses the set of reamers to remove the soft tissues from the sinus tarsi. Then, the cookie cutter reamer is used to obtain the round cancellous bony grafts, which are press-fit into the sinus tarsi. The stabilization is obtained by one cancellous screw inserted from superior to inferior that is parallel to the calcaneocuboid joint. The dual screw fixation is more stable: the anterior screw is located in the anterior facet, and the posterior screw is in the posterior facet. It permits WB as soon as the edema subsides (ca. one week after the surgery). Staples or canulated screws originally obtained the talonavicular fusion. Now the author prefers the use of the IoFix Intra-osseous Fixation device: the lag screw runs obliquely through the talus. It allows the excellent compression of the talonavicular joint surfaces. The implant is brace-friendly, does not cause skin irritation, never has to be removed, and allows early WB. The TN fusion allows overflexing of the first ray to avoid the cuneiform flexion osteotomy.

SURGERY SESSION 2

Extra-articular subtalar arthrodesis (Grice procedure) and talonavicular arthrodesis

Marek Jóźwiak

The foot surgery is usually part of SEMLS. The patient is in the supine position. The Silfverskiöld test assessment under anesthesia assesses the gastrocnemius tightness. The tourniquet is tightened. The first step is to lengthen the gastrocnemius. The presenter prefers the Vulpius procedure. The second incision is performed at the medial aspect of the foot above the talonavicular joint (below and anterior to the medial malleolus). The blunt dissection displays the medial aspect of the talonavicular joint. The tibial posterior tendon is reflected inferiorly. The recommendation is to resect bony fragments from the talar head and navicular proximal surface as small as possible. It is to protect the foot from forefoot abduction. The single staple obtains the stabilization. The following skin incision is performed at the lateral aspect of the foot just over the sinus tarsi up to the level of the peroneal tendons. The peronal tendons are reflected and protected. The soft tissues from the sinus tarsi are excised. Then, one removes the cortical bone from the inner sinus tarsi walls. The size and shape of the bony graft are determined before being packed into the sinus tarsi. It is fixed with a single staple. Before putting the staple, the presenter drills the holes for the staple arms. The foot is immobilized in a short or long leg cast (depending on the other parts of the SEMLS). WB is allowed after six weeks post-surgery.

Lateral column lengthening and first cuneiform plantarflexion osteotomy

Tom Novacheck

The equino-plano-valgus foot in CP combines the forefoot varus and hypermobile collapsed midfoot. The LCL through the neck of the calcaneus is done to address the midfoot instability. The technique was advocated by Mosca [9]. The osteotomy is through the neck of the calcaneus anterior to the posterior facet. The skin incision is oblique in line with skin lines from the anterosuperior to a posteroinferior aspect of the foot. The incision is superficial to avoid damage to the peroneal tendons and sural nerve (the latter runs with a small vein). The peroneal tendon sheath is opened with the scissors. The sural nerve is exposed and protected. The periosteum is cut anterior to the posterior calcaneal facet in the calcaneal neck region. The subperitoneal retractor is used. The Hohman retractors are placed planetary and dorsally. The osteotomy is performed anterior to the posterior facet with the saw and finished with the straight osteotome, leaving the medial periosteum intact like in the greenstick fracture to maintain stability. The direction of the osteotomy is oblique in two planes: it starts more proximal laterally. It ends more distal medially and, simultaneously, more distal dorsally and more proximal (close to the calcaneal tubercule) plantarly. Such osteotomy direction prevents the cuboid dorsal sublocation, and there is no need for calcaneocuboid pining. Once it is mobilized, the osteotomy can be opened by levering the osteotome, and then the smooth lamina spreader is inserted at the osteotomy site to maintain the opening. The osteotomy is typically open by a width of 8-12 mm, depending on the degree of the deformity and the patient's age. The bone graft is inserted and impacted until it is flush with the surface of the calcaneus. Next, the 1st cuneiform osteotomy is performed to restore the tripod by correcting the forefoot varus (the Cotton osteotomy – the transverse osteotomy opened dorsally to drive the I metatarsal head plantarly). The incision is between the extensor hallucis and tibialis anterior muscle on the dorsal foot aspect. The I-cuneiform bone can be located under an image intensifier or by palpation of the eminence of the 1st metatarsocuneiform joint. The bone is subperitoneously exposed. The elevator is inserted into the joint between the I and II cuneiform. The osteotomy is performed with the osteotome. The plantar side is left intact, acting as a hinge. We open the osteotomy dorsally by the osteotome or lamina spreader to plantarflex the first ray. The bone graft from the bone bank is trimmed to the correct size. Usually, the width of the graft is about 5 mm (4-7 mm). It is inserted and impacted at the osteotomy site. It is usually stable, not requiring any fixation. At Guillete, they did a retrospective review of patients between 9 and 13, GMFCS II and III. The control group was children with a non-operative approach. 50-70 % of the parameters in physical examination, multi-segment foot motion analysis, and WB radiographs improved. The author prefers the talonavicular fusion in patent GMFCS III and IV because it is a more powerful procedure in such cases. It is crucial to obtain a well-aligned foot in relation to the knee axis so the foot can act as the lever in the foot dorsiflexion-knee extension couple.

Foot lateral column lengthening and plication of talonavicular capsule

Lin Feng

Most of the time, the procedure is performed as part of the SEMLS. It is performed according to Mosca's Handbook [10]. The author always combines the LCL with medial soft tissue plication. The indication is the planovalgus foot deformity with the midfoot breakdown. The incision is obliquely situated between the calcaneal beak and the medial malleolus. The superficial peroneal nerve is present at the superior portion of the incision and the sural nerve is located in the lower portion of the incision. The dissection of the peroneal tendon sheath is performed. Then, one exposes the calcaneus with bone levers at the dorsal and plantar aspects of the bone. Under the image intensifier, the position of the dorsal lever is checked – it is supposed to be located between the medial and anterior facets. The author prefers inserting the 2 mm K-wire from the laterodorsal foot aspect to stabilize the calcaneocuboid joint and prevent its subluxation. The tip of the wire ends at the osteotomy site and is visible when the osteotomy is spread.

Then, the author inserts perpendicular Kirschner wires into the calcaneus proximally and distally to the osteotomy to use the Kirschner wire spreader to open the osteotomy. She checks under the image intensifier how much spread she gets and how the foot deformity corrects during the osteotomy site spreading process. In the next step, the bony autograft is put into this space and stabilized with the previously introduced K-wires through the calcaneocuboid joint. Then, the author does the medial plication according to Mosca's description: first, the Z-incision in the tibialis posterior tendon is done, then the resection of the redundant TN joint capsule is performed, we retighten the capsule and tibialis posterior tendon. After the procedure, the 6-week cast is used without WB. After six weeks, the pin and cast are removed, and WB is started. The author prefers to wait with the TN fusion if the deformity is flexible and the child is braceable after the plication of soft tissues.

Talonavicular and calcaneocuboid arthrodesis

Michael Wade Shrader

First-line surgeries for planovalgus foot in CP are plantar flexor lengthening, CLO, MCS osteotomy, and midfoot osteotomy. One shouldn't fuse joints in flexible deformities and highly functional patients (GMFCS I and many GMFCS IIs). TN fusion with LCL or calcaneocuboid fusion is a powerful correction in severe deformities. The correction takes place in the Chopart joint where the deformity is present. The indications for fusion are progressive symptoms, rigid, severe bony deformity, GMFCS IV and V, and obligate brace wearer in GMFCS II and III (e.g., need AFO for improved knee function). In these children, it is unlikely that they benefit from hindfoot motion, which is pathological. They are also unlikely to place high demands to develop adjacent joint arthritis. Preoperatively, WB or simulated WB X-rays, pedobarography (pressure indexes), and multi-segmental foot model Motion Analysis are taken. The lateral incision in line with the fourth ray is performed. We protect the sural nerve and peroneals. The broad exposure of the joint is crucial. We consider peroneus brevis lengthening or tenodesis. Then, the medial exposure is performed with capsular release. When the capsular release is done, the author evaluates the gastrocnemius contraction (the need for elongation is the intraoperative decision). Typically, the Stayer procedure is performed. The author encourages us to prepare the articular surface on both sides before obtaining fusion on one side. The combination of saw, osteotomes, curettes, rongeurs, and burr is used for joint preparation. The author prefers the curved osteotome and then the curettes. The burr is used to remove any residual cartilage and to shape the surface for arthrodesis. If there are concerns about joint surface vascularity, one can drill into the joint surfaces with a K-wire or the burr to get the stem cells to get to the arthrodesis site. The bony graft to be inserted into the calcaneocuboid join should be larger than the one used for CLO. The author prefers to stabilize the arthrodesis with the DynaNite staples that allow for the perfect compression, but the K-wires, plates, and screws might be used. High-quality skin closure is crucial in children with CP. The author uses subcutaneous sutures and typically chromic gut-interrupted sutures for the skin. Care must be taken, especially on the lateral approach, where the skin is tightened because of the severity of the deformity. The extraction with past padding with frequent cast changes/checks if any concerns are present.

In conclusion, hindfoot fusion is an excellent procedure to treat severe planovalgus deformities in CP with a low risk of recurrence. Fusion is not likely to have negative consequences for the CP children population. The key to success is good fusion surface exposure and preparation, and post-procedure skin care.

Transfer of the tibialis anterior muscle to the peroneus tertius muscle for pes eqiunovarus

Muharrem Inan

There are many techniques of tibialis anterior transfer: to the cuboid bone [11] to the 3rd cuneiform [12], split transfer to cuboid [13], and split transfer to peroneus tertius [14]. This transfer aims to increase the lever arm for the eversion force. The distal insertion point of the peroneus tertius is on the base of the fifth metatarsal bone, allowing the foot to get a good eversion force. Before the surgery, we check the dynamic deformities using the block Coleman test, the squizzing test for forefoot pronation and supination, and the confusion test [15]. The author uses the three-incision technique for split tibialis anterior muscle transfer. The first incision is at the dorsal foot just over the tibialis anterior insertion point. The tibialis anterior is elevated and split into medial and lateral parts. The author releases the lateral part of the tendon close to the distal attachment and preserves the medial part. We fix the tendon with the suture in the typical way. The second incision is lateral to the tibial anterior crest at the crus level. The TA is visualized. The hemostat follows the TA course antegrade under the extensor retinaculum. We pull the distal 1/2 of the TA tendon retrograde to split the tendon up to the second incision level. The third incision is on the dorsal aspect of the foot, just over the peroneous tertius tendon. The peroneus tertius is located just lateral to the fifth toe extensor tendon. The hemostat is placed through this incision up to the second incision level, and the TA tendon's lateral part is transferred to the peroneus tertius site under the extensor retinaculum. The Pulvertaft technique is used to suture the peroneus tertius and tibialis anterior tendons together.

The foot should be held in dorsiflexion and slight pronation throughout this process. The short leg cast is applied after the operation for six weeks. The WB is allowed from the 3rd day after the surgery. Between the 6th and 12th week, the author uses the AFO for walking. After the 12th week, active exercises with resistance are introduced to strengthen the muscle after transfer. The limitation of this technique is that 1/3 of children have no peroneus tertius muscle. Age indication for hemiplegic patients is up to four years old; for diplegic patients, it is not earlier than seven because, in many diplegic children, the natural course of the deformity is into the planovalgus foot.

GENERAL SESSION 2

The treatment outcome measure in the equino-plano-valgus foot

Unni Narayanan

The International Classification of Function, Disability, and Health for pes equino-plano-valgus resolves the problems of body function and structure (contracture, deformity, lever arm dysfunction, crouch gait, pain) [16]. These result in limitations in activities (walking, running), which compromise participation in sports, dancing, school activities, and spending time with friends. Environmental and personal factors additionally modulate this process. All surgical interventions are directed to resolve problems at the level of body structure. The assumption is that it will change the activity level and lower the participation restrictions. Measuring the surgery outcome at all levels (structure, function, decreasing limitations) is essential. The anatomic goals of treatment are to realign the bones and joints to restore the tripod, optimize the muscle length, and preserve flexibility at an acceptable level of recurrence risk. The biomechanics goals are to correct lever arms to obtain a stable platform for stance and push-off, which is mandatory to improve kinetics and kinematics. The symptomatic and functional goals are reducing pain, improving fitness and endurance, improving the appearance of gait, allowing for easier footwear choice, better stability, less tripping and falls, longer distance walking, and participation in more sports and recreational activities. To measure the anatomic values, one examines the foot and ankle range of motion to check whether we performed appropriate muscle lengthening. The assessment of the medial arch restoration, correction of the forefoot abduction (thigh-foot angle), hallux position, and torsional profile is crucial. On radiographic examination, the foot bones and joints alignment is analyzed considering foot as three segments and two columns.

Clinicians measure the talocalcaneal angle, Meary angle, and medial and lateral column axes and check whether the tripod has been restored and fusion obtained. The pressure index in pedobarography taken before and after the surgery is the objective way to asses if anatomy was restored after the procedure. The best measurement of outcome is the biomechanical outcome of optimization of lever arms in 3-D gait analysis (videographs, kinetics, kinematics, gait indices: Gillette Gait Index (GGI) [17], Gait Deviation Index (GDI) [18], Movement Analysis Profile (MAP) [19], Gait Profile Score (GPS) [19]). Functional outcome measure scores are Gross Motor Function Measure (GMFM) [1], Gillette Functional Assessment Questionnaire (FAQ) [20], Functional Mobile Score (FMS) [21], and GOAL Questionnaire [22]. GOAL was derived by assessing the patients' and their parents' goals in the outcome measure. It comprises 49 items over seven domains. The score is 0 to 100 points.

Marek Józwiak commented that for walking adolescents and young adults, foot pain is one of the most frequent locations of pain (after neck and back pain) and is more frequent than hip pain.

Post-surgery rehabilitation protocols and weight bearing after the surgery

Michael Wade Shrader

Correction of the planovalgus foot in CP involves either osteotomy or fusion. After these procedures, 6-8 weeks of non-WB was traditionally indicated. Radiographic evidence for bony healing should have been found to allow the WB. However, modern trends in adult trauma care have been to move towards early WB. Systematic reviews and randomized clinical trials indicate that early WB after ankle fracture has no adverse outcome compared to traditional protocols [23-25]. A similar trend exists in adult foot fusion surgeries with no adverse effects of early WB [26,27]. British Orthopedic Foot and Ankle Society summarizes the literature about early WB, indicating no adverse effects of early mobilization [28].

Freeman Miller advocated early WB in all procedures in CP, pointing out that modern fixation techniques have low failure rates. He argued that prolonged non-WB would add to the rehab time and burden [29].

The presenter found one article about the outcomes of early WB after distal femoral osteotomy in ambulatory patients with CP. The authors found no adverse effects of early WB and earlier return to physical activities [30].

The duPont protocol after the foot arthrodesis is a well-padded cast, split for two days. It is over-wrapped with the sole that is glued to the cast. The author starts WB as soon as tolerated. The patient spends 2 to 6 weeks in the inpatient acute rehabilitation unit, where they can gradually build up WB in ZeroG modifications [31]. There is a quick trigger to change the cast if there are any skin issues/pressure issues. After 6 to 8 weeks, the patient is weaned to solid AFOs to protect the results of bone surgery. To sum up, the early WB does not seem to have a premature hardware failure or increased rates of delayed unions, but more evidence is needed.

Take home messages

Bartosz Musielak

Proper clinical examination is the key: The Silfverskiöld test is still reliable, and WB X-rays are additional to the clinical examination.

Equino-plano-valgus deformity consists of forefoot varus, midfoot collapse, usually gastrocnemius tightness, and rarely soleus contracture. Biomechanics understanding is crucial: when the forefoot is in varus, and the hind foot is in neutral, the hindfoot is driven into valgus with tripod collapse during WB.

The decision-making process is based on the patient's age, severity of the deformity, GMFCS, and sagittal gait pattern. Most of the speakers agree that at the age <6, conservative treatment is advised (serial casting, botulinum toxin injections, orthotic treatment). Some authors advocate early surgical treatment (soft tissue releases). At ages 6-14, extraarticular procedures are sometimes advocated with TN fusion. In adolescence, arthrodesis is often indicated. Close cooperation with the orthotics and multidisciplinary team is essential.

New devices for more reliable correction and stable fixation are readily available, but traditional bone grafts and other fixation techniques are still relevant depending on surgeon experience and preferences. Stable fixation is crucial.

There are multiple surgical techniques available: soft tissues releases, LCL (through the anterior process of the calcaneus or the cuboid), MCS, wedge osteotomies of 1st cuneiform, medial soft tissues plication, TN arthrodesis, arthroereisis, Grice procedure, double of triple arthrodesis. In the equino-varus foot, tibialis anterior tendon transfer on the peroneus tertius muscle is an option. Usually, LCL is not enough (do not ignore midfoot and forefoot deformities). Fusions should be avoided in flexible deformities and high-functioning ambulators.

Summary

Michael Wade Shrader

It was highlighted that nowadays, surgeons focus more on the midfoot than just the hindfoot. The lecturer underlined the need for proper dose selection based on patients' functional demands, the deformity's flexibility, and family desires. It is worth trying to develop outcome measures for different clinical scenarios in the future and consider the procedure's longevity: whether choosing a more "powerful," more extensive procedure with a lower risk of recurrence is better over the joint-sparing surgery with higher recurrence rates. It will be crucial to give patients the date on how the surgery impacts their lives. The pain after the surgery is the challenge we should think about.

Marek Jóźwiak

The participants' numbers were summed up as in last year's edition [32]. The professor thanked the speakers, participants, sponsors, and technical team. He believes such webinars can increase the quality of care in many hospitals globally, and ended the session. This Webinar was watched live by an audience of about 583 people from 50 countries (Chart 1), with the most participants from Poland, Spain, Turkey, and the United Kingdom (Chart 2).

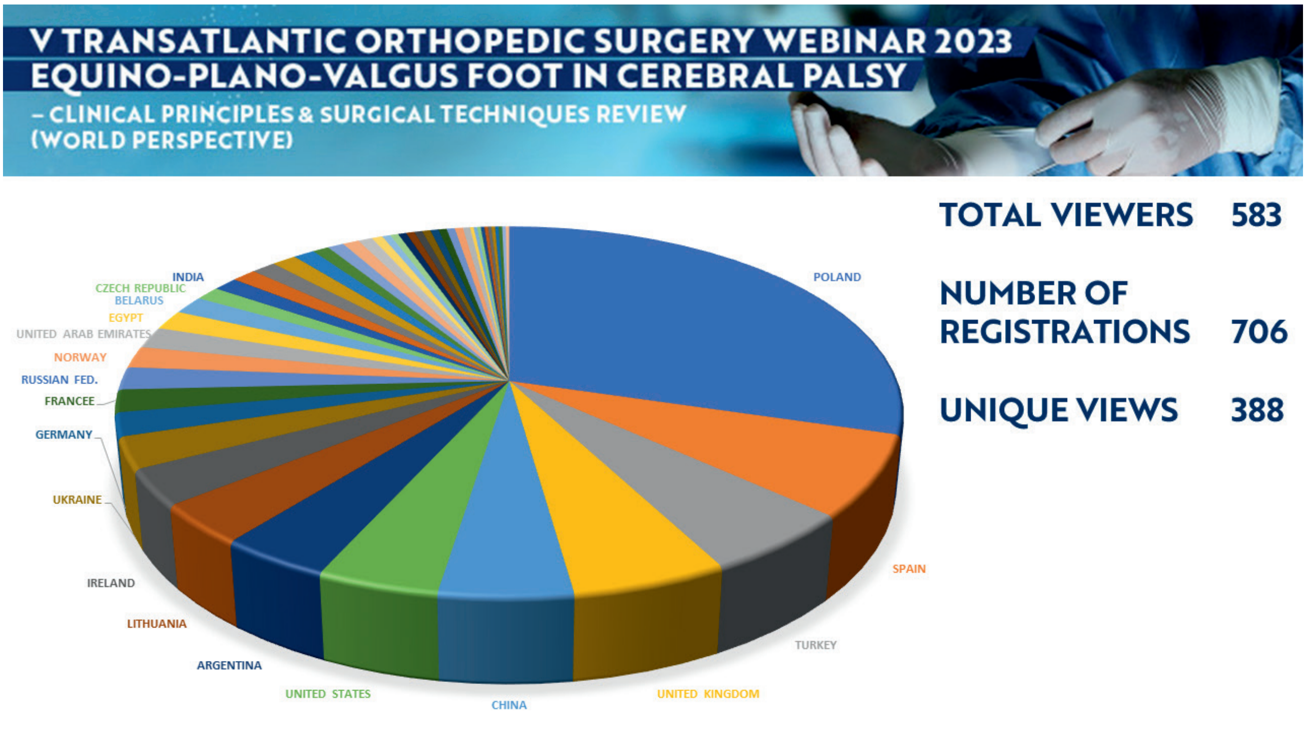

Chart 1. The distribution of the participants of the Webinar by country.

VIEWERS BY COUNTRY

POLAND	173	CZECH REPUBLIC	7	PORTUGAL	2
SPAIN	41	INDIA	7	SAUDI ARABIA	2
TURKEY	32	ESTONIA	7	SLOVENIA	2
UNITED KINGDOM	32	GREECE	7	SWITZEERLAND	2
CHINA	28	SWEDEN	7	ECUADOR	2
UNITED STATES	25	JAPAN	6	BOLIVIA	1
ARGENTINA	23	AUSTRIA	5		
LITHUANIA	21	BRAZIL	5	BOSNIA AND HERZEGOVINA	1
IRELAND	18	ITALY	5	GHANA	1
UKRAINE	16	COLOMBIA	4	JORDAN	1
GERMANY	12	VENEZUELA	3	LUXEMBOURG	1
FRANCEE	12	BELGIUM	2	MACAU	1
RUSSIAN FEDERATION	12	CANADA	2	PARAGUAY	1
NORWAY	11	CROATIA	2	PERU	1
UNITED ARAB EMIRATES	11	FINLAND	2	ROMANIA	1
EGYPT	10	GEORGIA	2	SRI LANKA	1
BELARUS	9	ICELAND	2	UZBEKISTAN	1

Chart 2. The list of the countries broadcasting the Webinar live.

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