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TRUELOK HEXAPOD SYSTEM

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Orthofix approach to Evidence Based Medicine

For years, clinical decision-making was based primarily on physician knowledge and expert opinion. Now, the medical community is searching for measurable outcomes "validating" efficacy of treatments. Evidence Based Medicine (EBM) is an approach that integrates individual clinical expertise with the best available evidence when making decisions about patient treatment. (Nierengarten MB et al. Using Evidence Based Medicine in Orthopaedic Clinical Practice: The Why, When, and How-To Approach. Medscape Orthopaedics & Sports Medicine. 2001; 5[1]). Over the last few years, there has been a significant growth in Evidence Based Medicine.

Document Objective:
This document contains the abstracts of all the presentations on TL-HEX during the ILLRS Congress - Miami 2015. The abstracts book can be downloaded at the following link:
http://illrsmiami2015.com/wp-content/uploads/2012/07/ILLRS-2015-FINAL-PROGRAM_GMB-1.pdf

To receive a digital copy of this Voice of Literature please submit your request to:

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1. INTRODUCTION

With the combined ILLRS/ASAMI congress pulling together around 500 specialists from countries across the globe, we took the opportunity to collect feedback and papers on the TL-HEX System creating the first collection of abstracts from a congress done by the Orthofix.

All the papers have been presented during the congress and they have in common three main points:

- They have been approved by the independent congress committee not influenced or guided by any member in Orthofix organization,
- Some of them will initiate specific scientific study,
- All the results and data are going to provide a wide view covering several points such as system stability, frame efficiency and preliminary clinical results, answering the most common and frequent questions.

This special edition of the "Voice of literature" is focused on TL-HEX System and it is a tool that can be used in the field and shared with the surgeons based on the work of experienced users. This document will allow to provide extra information in order to enhance the general knowledge of the system providing a better usability and tips for an improved application.

2. ILLRS 2015 - Abstract book

1. Hexapod circular external fixation in Treatment of Displaced and Comminuted Tibial Shaft fractures

Haim Shtarker (Israel), Pavel Nudelman, Michael Assaf, Mikhail Samchukov

Question: current treatment options for tibial shaft fractures have limitations when used for stabilization of unstable displaced or comminuted fractures. The purpose of this study was to review the initial experience with TL-HEX circular external fixation in treatment of displaced or comminuted tibial shaft fractures.

Method: since December 2012, 15 patients treated with the TL-HEX were retrospectively reviewed. Average age of the patients was 25.5 years (ranging from 8 to 88 years of age). In all cases, partial weight bearing was permitted immediately postoperatively while the full weight bearing was allowed to all patient during the first two weeks after surgery. After appearance of progressive callus formation, frame dynamization was performed.

Results: complete anatomical reduction of fracture was achieved in all cases. Superior frame stability and reduced rate of superficial pin tract infection was noticed in the majority of patients. No major complications were observed. Frame fixation time was the same as that when using other standard circular frames.

Conclusion: patients with mid-shaft tibial fractures can be successfully treated using the novel hexapod circular external fixation device. Unique key design features of the novel hexapod circular external fixator rings and struts considerably shortened the surgery time as well as significantly improved stability allowing immediate weight bearing and maintenance of joint range of motion.

2. Treatment of severe infected military injuries using hexapod circular external fixation

Haim Shtarker (Israel), Pavel Nudelman; Michael Assaf; Mikhail Samchukov

Question: the purpose of this study was to review different aspects of hexapod fixation in treatment of severe military trauma associated with severe infection and bone loss.

Method: 5 patients treated with TL-HEX were retrospectively reviewed. Immediately after admission, patients were transferred to OR for careful surgical debridement, taking cultures, massive washing of surrounding tissues and temporary unilateral external fixation. Broad-spectrum antibiotic treatment was initiated and different methods of soft tissue coverage were applied. Usually, unilateral external fixator was converged to the circular hexapod frame at that stage followed by osteotomy and initiation of bone transport. At the time of docking, threaded rods or cable were removed and replaced by the six hexapod struts for precise positioning of contacting bone segments followed by compression. Intravenous antibiotic treatment was continued for 1.5 to 2.0 months until normalization of CRP and clinical appearance.

Results: in cases available for follow up, healing and continuity of bone and soft tissue were recorded. No cases with recurrent infection were noted. Bone regenerate appeared in good quality in all cases and anatomical restoration at the docking was achieved.

Conclusion: hexapod circular external fixation can be recommended for treatment of severe military trauma. TL-HEX in our cases provides superior stability due to slotted ball-and-socket universal hinges. Due to strut attachment on the outer surface of the rings, switching from ring based or cable-based bone transport to hexapod configuration at the docking site was very simple and not time consuming. Device was tolerated by all patients and they were able to manage either bone transport or docking site compression away from the hospital and without the medical aid.

3. Fracture reduction; limb reconstruction using a novel hexapod circular external fixator: Initial experience in Israel

Haim Shtarker (Israel), Pavel Nudelman, Mochael Assaf, Mikhail Samchukov

Question: temporary frame instability, complexity of strut adjustment, and lack of preoperative planning are well-known limitations of the existing hexapod-type external fixators. The purpose of this study was to review the initial experience with TL-HEX circular external fixation in fracture reduction and limb reconstruction.

Methods: charts and radiographs of the 35 patients (25 fractures and 10 limb reconstruction) treated with the TL-HEX circular external fixation since December 2012 were retrospectively reviewed.

Results: external fixator required significantly less time for pre-assembly, intraoperative strut removal or re-attachment and was user-friendly in postoperative strut length adjustment. All patients in fracture group achieved desirable reduction and healing while limb lengthening or/and re-alignment was accomplished in all patients in limb reconstruction group. Comparison of deformity parameters with final limb alignment demonstrated high precision of the TL-HEX software in either preoperative or postoperative planning modes. Superior frame stability and reduced rate of superficial pin tract infection was noticed in the majority of patients. No major complications were observed except one case of nonunion after proximal tibial osteotomy. In this case, frame was re-applied to the extremity and the union was achieved.

Conclusion: TL-HEX can be successfully applied in treatment of patients with fractures and limb reconstructions.

4. Reduction of number of hexapod strut changes using smart phone software iStrut

Konstantin Mikheev (Russia), Petr Vvedenskiy, Mikhail Samchukov, Alexander Cherkashin

Question: due to oblique strut orientation relative to the axis of bone segments, postoperative management of hexapod-type of external fixators often required strut exchanges. In some cases with severe multi-planar deformities and significant limb lengthening, up to 5-6 struts should be replaced during the treatment. Strut exchange is a time-consuming process that required temporary ring stabilization followed by strut replacement. Therefore, the purpose of this study was to develop a software program that will allow to optimize the strut length and reduce the number strut exchanges.

Methods: to provide the efficient and reliable mean for strut length configuration optimization, the iStrut program was developed as an application for the iPhone and iPad. The program requires to enter the parameters then will run the strut length optimization module and provide optimized strut size and rapid/gradual strut lengths. The struts can be adjusted immediately resulting in the most efficient daily strut adjustment prescription with minimal amount of strut length modifications and strut exchanges.

Results: the program was tested for different types of deformity correction and limb lengthening experimentally and then validated by several different surgeons in clinical practice. In all cases, iStrut program allowed to select the most optimal sizes and configurations of struts.

Conclusion: application iStrut allows to select the most optimal strut sizes and their acute/gradual length configuration immediately after the surgery directly in the OR. This will significantly reduce the number of strut length modifications and strut exchanges during the deformity correction and limb lengthening using the hexapod frame. Saved in the application optimized strut length configurations can be entered into the hexapod software at surgeons convenience at the later time.

5. Comparative conformational instability of different hexapod frames

Mikhail Samchukov (USA), Barbara Chiaramonti, Sergey Leonchuk, William Pierce, A. Cherkashin

Question: the purpose of this biomechanical study was to analyse whether the type of the universal joint utilized in struts structure affects the overall conformational instability of the hexapod frame. We hypothesized that hexapods with cardan-type universal joint of the struts allow more frame instability than hexapods with ball-and-socket universal joints and the magnitude of the hexapod frame instability is inversely proportional to the angle between the rings and struts as well as separation distance between the rings.

Method: four hexapod external fixators were utilized in the study including two frames with the cardan-type universal joint (Taylor Spatial Frame, Smith & Nephew Orthopaedics, Memphis, TN and Ortho-SUV, S.H. PITKAR, India) and two frames with ball-and-socket universal joint (PoliHex, Litos, Hamburg, Germany and TL-HEX Ring Fixation System, Orthofix, Verona, Italy). The mechanical testing was performed by using a universal testing machine (MTS 858, Minneapolis, MN) applying a 5-N load to detect the free play while avoiding the frame deformation. The study was divided into three phases: 1) maximal axial free play of the individual struts, 2) comparative free play evaluation of the standard hexapod frame assembly. The groups were compared statistically using one-way ANOVA test.

Results: PoliHex and TL-HEX hexapod struts with ball-and-socket universal joints demonstrated statistically significant.

Conclusion: type of the universal joint utilized in the struts structure affects the overall conformational instability of the hexapod frame. The hexapod frames with cardan-type universal joint of the struts have more instability than hexapods with ball-and-socket universal joints. The magnitude of frame instability in the hexapods with the cardan joints is inversely proportional to the angle between the rings and struts as well as distance between the rings. Hexapod frames with ball-and-socket universal joints have superior frame stability independent on ring-to-strut angle and ring separation distance.

6. Strut-to-bone lengthening ratio in hexapod external fixators

Alexander Cherkashin (USA), Christopher Iobst, Mikhail Samchukov

Question: the purpose of this study was to find a correlation between the rate of bone lengthening and strut length adjustment in a hexapod frame. Specifically, what is the rate of strut length adjustment necessary to achieve 1 mm of daily bone length increase?

Methods: the study was performed in two stages. Initially, a software simulation of the straight lengthening was performed using two commercially available hexapod frames. Strut-to-bone lengthening ratio was calculated for each hexapod frame for various ring sizes and ring separation distances. Calculated ratio between the strut and the bone length changes was then validated in several assembled limb lengthening configurations for both hexapod frames.

Results: comparative analysis of the strut and bone rates of lengthening in those cases using both computer program simulation and assembled hexapod frame configurations demonstrated that 1 mm of length increase in each of the struts always produced more than 1 mm of bone lengthening. Although the resulting amount of bone length increase was influenced by various frame and mounting parameters (rings diameter, struts length, ring separation distance, etc.) but it was always more than 1 mm, ranging from 1.3 mm to 4.8 mm.

Conclusion: in any hexapod frame configuration for limb lengthening, 1 mm of struts lengthening produces more than 1 mm of bone length increase. The strut-to-bone lengthening ratio depends on numerous frame and mounting parameters and, therefore, fluctuates during the limb lengthening. To achieve 1 mm bone length increase struts should be adjusted to a lesser amount. When using hexapod frames with minimum struts adjustment rate of 1 mm, each adjustment may produce an acute overstretching of the newly forming tissues resulting in pathological forms of distraction regenerate and its delayed consolidation.

7. Comparative hexapod frame free play evaluation using The mathematical modeling

Petr Vvedenskiy (Russia), Konstantin Mikheev, Mikhail Samchukov, Alexander Cherkashin

Question: it is well-known that all the existing hexapod-type external fixators have a certain degree of free play between the external supports due to numerous mobile connections in their struts. The purpose of this study was to investigate how does the free play between the rings of hexapod-type fixation devices depends on the frame configuration, specifically distance and angle between rings.

Methods: The mathematical modeling of the free play along the axis of the rings was performed using a specially developed computer program allowing creating the 3D virtual models of frames with regard to their real geometry. Four commercially available hexapod fixation devices were utilized including TSF (Smith & Nephew Orthopaedics, Memphis, TN), TL-HEX (Orthofix, Verona, Italy), Ortho-SUV (S.H. PITKAR, India), and PoliHex (Litos, Hamburg, Germany) frames. The ring sizes and their relative location (angle and separation distance) were entered into the program to simulate a specific device configuration.

Results: in all testing modes, the TL-HEX hexapod demonstrated the minimal values of the free play with the minimal deviation of the free play values with changes in the ring separation distance and ring orientation angle. Overall, those free play values for the TL-HEX frame were 3 times less than those for the TSF, 4 times less than Orto-SUV frame free play, and 2 times less than the free play values for the PolyHex. Obtained theoretical free play values were validated experimentally using four mentioned above devices in the similar frame configurations.

Conclusion: the developed computer program can be useful for orthopedic surgeons as the tool of selecting the optimal hexapod frame configurations with the minimal amount of free play. The free play values obtained with mathematical modeling are reliable and can be implemented for different hexapod frames and in different configurations.

8. Comparative analysis of the trajectory of bone segments movement in the hexapod frames

Petr Vvedenskiy (Russia), Konstantin Mikheev, Mikhail Samchukov, Alexander Cherkashin

Question: although modern hexapod-type of external fixators allowed simultaneous correction of multi-planar deformities in 3D space, the trajectory of bone segment movement due to adjustment of the six struts can be deviated from the straight (or arched) line. Therefore, the purpose of this investigation was to analyze the trajectory of bone segments movement using two hexapod frames. More specifically, what is the deviation of that trajectory from the straight line?

Methods: the mathematical modeling of bone segments movement was performed using a specially developed computer program allowing to reconstruct the trajectory of this movement in the hexapod frames. Two commercially available hexapod frames were included in the study including TSF (Smith & Nephew Orthopaedics, Memphis, TN) and TL-HEX (Orthofix, Verona, Italy).

Results: using those two approaches, the trajectory of bone segments movement were calculated for different types of deformity correction and lengthening. The analysis of trajectories modeled using the TL-HEX prescription algorithm revealed that bone segments are always moving along the straight line with equal amounts of movement per each increment. All the trajectories of bone segments movement modeled using the TSF prescription approach were curvilineal or spiral-shaped with significant deviations from the straight line during each increment of movement reaching more than 15 mm.

Conclusion: prescription algorithm of the TL-HEX hexapod frame is more optimal for bone segments movement than that for the TSF. The implementation of the algorithm used in the TL-HEX software allows to move the bone segments during deformity correction and limb lengthening within the trajectory nearly close to the straight line.

9. Comparison of hexapod fixator systems

Christopher Iobst (USA), Mikhail Samchukov, Alex Cherkashin

Question: multiple hexapod-type external fixators are now available for surgeons to use. The design of these fixators can be divided into two types of systems: 1) struts that utilize ball and socket joints attached to the outer surface of the rings and 2) struts that utilize a cardan type universal joint attached to the undersurface of the ring. This study compares the range of clinical capabilities of each design and identifies any advantages and disadvantages associated with each type.

Method: a hexapod frame consisting of two rings and six struts was constructed using each design type, the cardan type universal joint and the ball and socket joint. Three different sets of strut sizes were tested on each ring, small (short), medium, and long. Starting with each strut in the neutral position, the frames were deformed into maximum coronal plane angulation, sagittal plane angulation, coronal plane translation, sagittal plane translation, rotation, and length. For each of these configurations, the software was used to create the maximum amount of each deformity until the limit of each particular strut size was reached. The deformities were pure in each plane without any induced secondary deformity. The frames were then tested on the amount of deformity correction possible before soft tissue impingement inside the rings would occur.
Using the software, the two different ring/strut designs were compared for the amount of strut changes necessary to achieve full correction of several different types of deformities. For Blount disease, two different deformities were created, one with moderate deformity parameters and one with severe deformity parameters.

Results: both the cardan type universal joint and the ball and socket joint hexapod frame designs allow significant multi-planar correction to occur. In the smaller size struts, the cardan type universal joints allow more translation and rotation while the ball and socket joints allow more length. For large rotational corrections and frames built with 90 degrees of offset, the ball and socket joint design may be better at avoiding soft tissue impingement. While systems are comparable with mild to moderate deformity correction, the ball and socket joint design allows more correction with less strut changes for severe deformity types.

Conclusion: while systems are comparable with mild to moderate deformity correction, the ball and socket joint design allows more correction with less strut changes for severe deformity types.

10. Initial experience using the TL-HEX system in pediatric tibial deformity patients

Christopher Iobst (USA)

Question: new software assisted hexapod external fixators are now available to surgeons. How does the new ball and socket joint hexapod fixator from Orthofix (TL-HEX) perform when correcting multi-planar tibial deformity in children?

Method: a retrospective review of the first ten cases using the Orthofix TL-HEX was performed.

Results: the average age was 12.5 years, there were 7 males and one female. The underlying etiology was adolescent tibia vara in five cases, infantile tibia vara in three cases and multiple hereditary exostosis in two cases. All other pre-operative deformities were successfully corrected to normal with the TL-HEX. All osteotomy sites and regenerate bone healed primarily without delay or the need for adjunctive treatment. The average frame duration was 126 days. Only one case required a planned strut change to achieve full deformity correction. There were no fractures after fixator removal at an average of 7.6 months follow-up. Three patients had superficial pin track infections requiring oral antibiotics during the course of treatment. One patient's parent did not follow the adjustment prescription and corrected the deformity faster than desired but did not cause any healing complications. One patient had a strut come loose from the ring during the consolidation phase but did not lose any correction.

Conclusion: the Orthofix TL-HEX system is a safe and accurate method for performing multi-planar correction of pediatric tibial deformities. The system was also noted to require a total of only one strut exchange to achieve full correction in this group of ten cases.

11. New kid on the block - The TL-HEX frame: how does it compare to Taylor Spatial Frame? - Direct comparison of results in the treatment of severe open tibial fractures

Konstantinos Doudoulakis (UK), John Hardman, Satyajit Naique

Question: TSF is an established hexapod device widely used in the treatment of severe fractures and for deformity correction. The TL-HEX frame is a new generation hexapod device that claims to offer numerous unqualified advantages for both surgeons and patients. These include an easier surgical technique, friendlier computer software, and a more stable construct . However, clinical studies have yet to prove its efficacy and safety, and to confirm its superiority. In this single surgeon series, we set to make a direct comparison the TSF and TL-HEX frames and examine in detail the clinical and surgical outcomes.

Methods: all patients with open fractures (GA grades 2 to 3C) presenting to our Major Trauma Centre from 2011 onwards and who had received combined orthoplastic treatment with a circular hexapod frame were selected (53 TSF and 15 TL-HEX). Of these, 77 patients completed their treatment at our unit (38 TSF and 15 TL-HEX).

Results: patients treated with the TL-HEX frame all exhibited bony union with a mean time to union of 177.5 days. Of the patients treated with TSF frames, 8 failed to unite, whereas the mean time to bone union for the rest was 243.7 days. Frame complications in the TL-HEX group were 5 episodes of strut extrusion in 4 patients, five patients developed a superficial infection. TSF complications comprised of one instance of extrusion and two instances of broken wires.

Conclusion: early results show an advantage of using TL-HEX frames for the treatment of severe open tibial fractures. Bony union times are quicker for equivalent fractures, and outcome scores of both bone healing and function are higher. A high incidence of strut extrusion may require further investigation.

12. Early experience of using a new hexapod circular frame in the management of severe lower limb trauma

Konstantinos Doudoulakis (UK), John Hardman, Satyajit Naique

Question: circular frame Hexapods have been used for treating fractures and deformity for the last 20 years. However the most commonly used hexapod (Taylor Spatial Frame) has some inherent shortcomings in the treatment of fractures. To address these issues and improve patient and surgeon experience as well as clinical results, the TL-HEX hexapod circular frame has been introduced in December 2013. As early users we describe our experience from its use in the management of severe lower limb trauma.

Methods: 26 patients presenting with high energy lower limb trauma and treated in a combined orthoplastic approach using TL-HEX circular hexapods frames were selected. All operations are performed by a single surgeon experienced in using circular frames for the last 15 years. All patients included had completed treatment and had had frame removal. All patient had either acute on-table correction or post-op computer guided programs, or both. TL-HEX struts were used in all cases. All patients were allowed to fully weight bear immediately.

Results: no patients were lost to follow up. All fractures healed, Average union times were 118.4 days for closed fractures and 177.5 days for open fractures. There were 6 instances of superficial infection, and one instance of residual values deformity of more than 7 degrees (10 degrees). Complications included 5 instances of strut extrusion in 4 patients.

Conclusion: despite a moderately high incidence of strut extrusion, bone union is 100% while time to union is low, with few complications, and outcome scores are high. Early experience suggests that this is a safe and effective device to use in the treatment of severe fractures of the lower limb.

13. Case review of 15 consecutive deformity cases to evaluate the new TL-HEX system

Sean Pretorius (South Africa)

Question: what was the clinical outcome of our first 15 deformity cases using the TL-HEX system with regard to deformity correction and ability to maintain the reduction?

Method: 15 consecutive cases with different deformities where corrected using the Hexapod frame. These patients where then evaluated with X-Rays and clinically to ascertain whether the deformities where in fact corrected and how many attempts did it take with the software to correct the deformity.

Results: all cases, except one tibia case, where corrected with one software correction. Joint deformity cases all had a second correction to close down the joint space that was purposefully distracted as part of the deformity. One frame had wire breakage on 2 occasions but this did not affect the maintenance of the deformity. No major infections have been noted at the pin sites.

Conclusion: the TL-HEX System is very effective for deformity correction in the lower limb and is almost 100% accurate. The system is also very stable for maintenance of deformities with excellent union rates.

14. Hexapod external fixation closed distraction in the management of stiff hypertrophic and oligotrophic tibial non-unions

Nando Ferreira (South Africa), Leonard Charles Marais

Question: can closed distraction with hexapod circular external fixation effectively treat stiff hypertrophic and oligotrophic tibial non-unions?

Methods: we performed a retrospective review of all stiff hypertrophic and oligotrophic tibial non-unions treated by hexapod closed distraction between January 2010 and January 2014.

Results: 46 hypertrophic and oligotrophic tibial non-unions were included. No tibial osteotomies or bone graft procedures were performed. Bony union was achieved after the initial surgery in 41 (89.1%) tibias. Four persistent non-unions united after repeat treatment with closed hexapod distraction. This resulted in final bony union in 45 (97.8%) tibias. Leg length was equalized to within 1cm of the contralateral side in all tibias. Mechanical alignment was restored to within 5 degrees of normal in 42 (91.3%) tibias.

Conclusion: Closed distraction of stiff tibial non-unions can produce predictable union without further surgery or bone graft. In addition to generating, the required distraction to achieve union, hexapod circular external fixators can accurately correct concurrent deformities and limb length discrepancies.

15. Radiographic analysis of hexapod external fixators fundamental differences between the Taylor Spatial Frame and the TL-HEX

Nando Ferreira (South Africa), Franz Birkholtz

Question: how do the Taylor Spatial Frame and TL-HEX differ with regard to radiographic analysis for deformity correction planning?

Methods: a sawbone model was created to simulate a midshaft-tibial fracture with deformity. A 180 mm ring was applied oblique to the proximal segment of the sawbone model, in both the sagittal and coronal planes. Standard radiographs were taken of the model and analyzed using the described Taylor Spatial Frame and TL-HEX methods.

Results: the TL-HEX software allows the surgeon the ability to program reference rings that are not orthogonally mounted. Apart from this software difference, the described analysis methods resulted in variation in all translational measurements for both deformity and mounting parameters.

Conclusion: The radiographic analysis of the Taylor Spatial Frame and TL-HEX are fundamentally different. These differences must be appreciated in order to use these systems effectively.

16. Femoral lengthening in children using a new hexapod fixator: preliminary results

Franck Launay (France)

Question: the objective of the study is to report the first cases of femoral lengthening in children using a new hexapod fixator.

Methods: we carried out a retrospective study about cases of femoral lengthening done in 2013 and 2014 in our institution.

Results: 12 lengthening were done during this period in 11 patients using the TL-HEX, a new hexapod fixator. The procedure was done in congenital bone in 10 cases and after a distal femoral epiphysiodesis in 2 cases. The mean age at surgery was 11,8 years. A lengthening was required in all patient and an axis correction was required in 8 of the 12 cases. The mean lengthening was 4,9cm. The healing index was 43,5 day/cm (25,5-60). We noticed 2 fractures above the lengthening zone several months after the hardware removal, 2 knee stiffness, 6 local infections, and 1 broken half-pin. The goal of lengthening was reached in all cases. The goal of axis correction was reached in 87,5% of cases.

Conclusion: the use of this new hexapod system allows to do accurate lengthening and axis correction, and is a reliable external fixator.

17. TL-HEX system used to correct a fixed equniovarus deformity of an ankle

Stephen J. Frania (USA), Carl B Lindberg

Question: can the TL-HEX System be used to correct an equinovarus deformity?

Methods: we applied the TL-HEX System by Orthofix with tibia and fibula osteotomies and gradually corrected the deformity over six weeks.

Results: the external fixation system was removed after 8 weeks. A bridge plate was then applied to the medial aspect of the tibia to hold correction obtained. The ankle was noted to be in rectus position with the deformity corrected.

Conclusion: the TrueLock External Fixation system is a viable option to gradually correct complex foot and ankle deformities. In addition, a bridge plate may be used upon external fixation removal to reduce nonunion.

18. The use of Gradual Correction with the TL-HEX external fixator in Blount's disease

Pieter Maré (South Africa), David Thompson

Question: what is result of gradual correction with the TL-HEX external fixator in Blount's disease in terms of accuracy of correction, union and complications?

Methods: a retrospective chart and X-Ray review of 7 patients (9 legs) treated by gradual correction with the TL-HEX external fixator was completed. Degree of correction of varus and procurvatum was assessed on pre-operative and post-correction X-Rays. Internal rotation deformity correction was assessed clinically. Complications such as neurovascular compromise, minor and major pin tract infection and hardware complications were documented. The pre-operative planning, surgical technique and post-operative treatment protocol was reviewed.

Results: mean varus was corrected from 21° (17° to 45°) to 1°(-2° to 4°). Mean pro-curvatum was corrected from 8° (0° to 25°) to 0° (0° to 8°). Internal rotation was corrected to between 5° to 10° of external rotation in all patients. Three patients needed one additional program to correct residual deformity. The mean time in frame was 112 days. Three patients required oral antibiotics for minor pin tract infection. One patient required intravenous antibiotics and wire removal for major pin tract infection. One patient required frame adjustment after correction for soft tissue impingement. One strut loosened after consolidation prior to frame removal.

Conclusion: gradual correction of Blount's disease with the TL-HEX external fixator is a safe and effective treatment method.

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