Wire-related nerve injury was identified in one of these cases, whereas in the other 3 patients osteotomy with acute deformity correction appeared to cause the problem.
During apparatus application to the upper extremities, radial response attenuation was identified in 2 instances. No corrective actions were performed in one of the case which had humeral frame application, because changes did not reach criteria of significance. The patient experienced symptoms of sensory radial nerve deficit postoperatively. In the other case with forearm frame application, immediate wire removal was undertaken after the detection of response abnormalities. This resulted in substantial response restoration and prevention of postoperative nerve dysfunction.
Conclusion: SSEP monitoring was demonstrated to be a technically feasible and clinically reliable technique for the assessment of nerve compromise during external fixation of the lower and upper extremities. The technique may improve the safety of external fixation procedures, and therefore can be a valuable adjunct to surgical instrumentation.

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Послеоперационное обследование - больше функций в компьютерной системе планирования при исправлении деформаций нижних конечностей с помощью компьютера

Post-surgery examination - more functions in computer-aided planning system for lower extremity deformity correction

Создана компьютерная программа, позволяющая планировать процесс исправления деформаций нижних конечностей.
Предоперационное планирование устранения деформации с помощью компьютера с применением аппарата Илизарова может значительно повысить шансы на успех и облегчить процесс применения. Время, отводимое на создание клинически верной конструкции, значительно уменьшается при применении предоперационной программы планирования. К ранее созданной программе добавлена система планирования функциональности послеоперационной выверки. Эти функции позволяют модифицировать предоперационный план с тем, чтобы более точно отразить остеотомию и положение конструкции, действительно достигаемые во время операции. Это, в свою очередь, позволяет спрогнозировать процесс устранения деформации на весь период лечения, используя предварительно собранную конструкцию, составленную при предоперацинном планировании.
Abstract We have previously reported here the development of a computer assisted surgery planning system for lower extremity deformity correction using the Ilizarov method. The hardware of the system is composed of an ultrasonic digitizer as input device, a HI plotter as output device, and a 386 / 486 Personal Computer, SuperVGA monitor, and a mouse. The main program is a menu- driven 2-D graphics program dividing the planning procedure into several major steps. More functions have been added to our program: Post-Surgery adjustments and Examinations. Since it is very difficult to make the osteotomy and place the external flxators exactly as they are planned in preoperative stage, the post-surgery adjustment is necessary to observe and predict the correction process. The functions of these additional components to the program include the modification of osteotomies and adjustment of the placement of the external fixator.

Introduction
In applying the Ilizarov technique for the treatment of lower limb deformities, external fixators are used during the whole treatment process [1]. There are three phases involved. The first phase consists of preoperative planning of deformity correction including frame preconstruction. This phase is greatly aided by our original computer program which determines the weight-bearing axis of the bone, allows development of a strategy for deformity correction using up to three osteotomies, and provides specific information regarding the geometry of the preconstructed frame and the rate of deformity correction. The second phase is surgery when the frame is fixed on the deformed bone and the bone divided. In the third phase (correction), the relative positions of the frame components are changed at the prescribed rate. In this way, the deformity of the bone is gradually corrected.
It is very difficult for the geometry of the osteotomy or the position of the preconstructed frame as predicted from the preoperative planning phase to be exactly reproduced at surgery. So, it is essential that the computer-aided planning system is able to change the level of the osteotomies and adjust the position of the external flxator to mimic those actually achieved at. Only in this way can the system mimic the actual correction process and examine it frequently by comparing the x-ray film and the information provided by the system.
Functions Implementation
Two Functions have been added to the system in order to perform the post-surgery examination, "Osteotomy Adjustment" and "Frame Adjustment". The function "Osteotomy Adjustment" allows the user to change the level and orientation of each osteotomy from the original ones created during the preoperative planning phase. To effect this function, the operator opens the original, stored preoperative plan and alters the preoperative osteotomy site and orientation to reflect the actual osteotomy created during the surgery phase.
The function "Frame Adjustment" allows the user to move the preassembled frame now fixed to the bone during the surgery phase in the 2-D plane corresponding to the bone deformity plane. The movement of the frame is performed in two steps. First, the entire frame may be shifted by pointing the cursor anywhere in the area of frames and holding the mouse. When mouse moves, the whole frame will move along with the cursor. The second step is rotation of the frame. The rotation center will be at the point where the cursor pointed when shifting the components. The combination of shifting and rotation can be used to achieve repositioning of the frame to any orientation in the deformity plane.
Fig. I shows the presurgery bone shape with intended frame construction, orientation and osteotomy site and geometry. Fig. 2 shows alteration of the osteotomy level and orientation of the frame on tibia, using the "Postoperative Modify" feature of program. Fig. 3 shows the result of angular correction with the modified osteotomy level and frame location on the bone after surgery.
Summary
Computer-assisted preoperative planning of deformity correction using the Ilizarov apparatus can greatly enhance the success and ease of application of the process. The time spent creating a clinically appropriate frame is significantly reduced in our experience using the preoperative planning program. We have now added the post-surgery adjustment functionality to the planning program. These functions allow us to modify the preoperative plan to more accurately reflect the osteotomy and frame location actually achieved during surgery. This in turn allows us to predict the deformity correction for the whole treatment period using the preconstructed frame developed during the preoperative planning.

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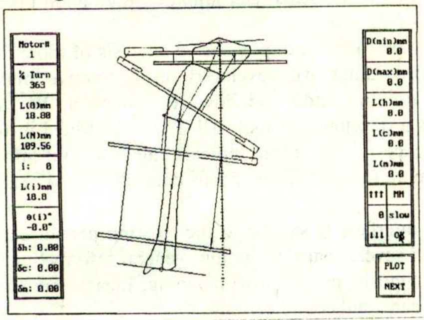

Fig. 1 Pre-surgery Planning of Tibia

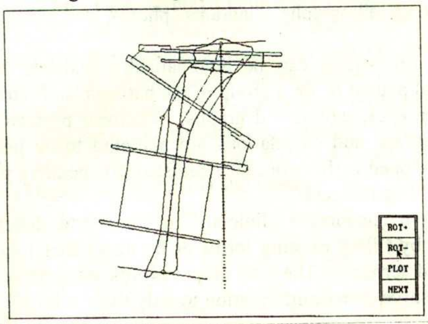

Fig. 2 Post-surgery Modify

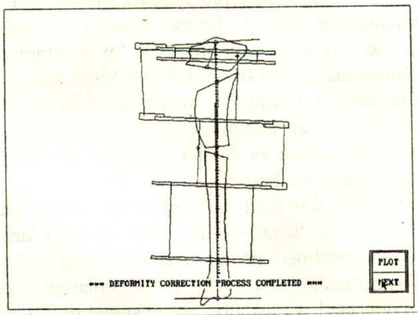

Fig.3 Correction Result on Modifications

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Костные трансплантаты и заменители при перемещении костных фрагментов[2]

Bone grafts and substitutes in Ilizarov bone transport

Цель исследования состояла в том, чтобы оценить различные виды костных трансплантатов и искусственных материалов, применяемых для формирования костного регенерата.

Проведено 4 группы экспериментов на 11 зрелых кастрированных козлах: группа I (2) - регуляция костной резекции; группа II (3) - использовался свежий аутогенный кортикальный костный трансплантат; группа III (3) - костный аллотрансплантат, стерилизованный в окиси этилена; группа IV (3) - костный заменитель коралловый гидроксиапатит (проостеон 500). Стандартный аппарат Илизарова с двумя блоками по два кольца накладывали на голень. Резецировали 30% диафиза большеберцовой кости. Надкостница была резецирована из области перемещения. Цилиндрический блок 20 мм длиной и 12 мм в диаметре из перемещаемого материала был скомпрессирован с оставшимся костным фрагментом. Продольное перемещение по 0,25 мм х 3 раза в день начинали после 7-21 дней латентности и продолжали 70 дней. Период фиксации после перемещения составил от 6 до 8 недель.

Результаты. В группе I дефект у животного с полной периостальной резекцией заполнялся фиброзной тканью, в то время как дефект у животного, у которого периост сохранялся, был устранен за 168 дней. В группе II у животных с использованием аутотрансплантата и 7-дневной латентности образовался типичный костный регенерат между исходным и перемещаемым фрагментами. В группе III и IV у животных с 7-дневной латентностью костный регенерат образовался только из сохраненного фрагмента кости, а не из перемещаемого материала. После 14 и 21-дневной латентности регенерат образовался и от сохраненного фрагмента, и от перемещаемого материала. У животных II и III групп с использованием аутотрансплантата и аллотрансплантата перемещаемые фрагменты в ходе перестройки становятся остеопеническими, что привело к переломам в нескольких случаях. У животных IV группы коралловый материал не резорбировался в течение всего периода исследования.

Introduction. In 1969, G.A. Ilizarov described a method of filling long bone defects by a technique of internal movement of an intercalary fragment known as bone transport. The technique involves a bony division of one or both intact bone fragments and generation of new bone by distraction of this adjacent segment of bone. Although bone transport has become an important reconstructive tool for the orthopaedic surgeons, this method still has some limitations in the treatment of fractures with severe bone loss, osteomyelitis, or tumors, in cases of very short length of residual bone stumps. The purpose of our study was to evaluate different types of bone grafts and artificial materials as intercalary transport fragments.

Materials and methods. Eleven skeletally mature neutered male goats were used for this study. They were randomly placed into one of the following four treatment groups: group I (n=2), bone resection control; group II (n=3), fresh autogenous cortical bone graft; group III (n=3); allograft bone sterilized in ethylene oxide; group IV (n=3); bone substitute coralline hydroxyapatite (Pro Osteon 5ffl) ®. A standard two double-ring block Ilizarov frame was secured to the tibia using six 1.8 mm wires. A resection of 30%) of tibial diaphysis was performed using two predrilled corticotomies. The periosteum was resected from the area of transport. The 20 mm long 12 mm diameter cylindrical block of transporting material was compressed against the residual bone fragment and secured by two cross wires to the fifth ring of the external fixator. Distal longitudinal transport 0.25 x 3 times per day begun after 7-21 days of latency and continued for 70 days. Fixation period after transport was 6 to 8 weeks. New bone formation was evaluated radiologically at weekly intervals during transport and biweekly during fixation period. At sacrifice bone regenerate with adjacent fragments were removed en-bloc for the histological evaluation (pending).

Results. In group I, the defect of the animal with complete periosteal resection contained fibrous tissue, whereas the defect of the animal in which the periosteal sleeve was left intact had completely filled in with bone by 168 days. Group 11 animals using autogenous bone transport and a 7 day latency produced typical bone regenerate between the original and transport fragments. In group Ill and IV animals using a 7 day latency, the regenerate new bone formed only from the host fragment and not the transport material. Following a 14 and 21 day latency, regenerate new bone was formed from both the host fragment and transport materials. In the autograft (group 11) and allograft (group Ill) animals, the transport fragments became osteopenic with remodeling resulting in fracture of the fragment in several instances. In the group IV animals, the coralline material was not resorted during the period of study.

Conclusions. Transport using fresh autogenous cortical graft after 7 days of latency produced typical bone regenerate found with distraction osteogenesis. Using bone allograft or coralline hydroxyapatite and a 7 day latency, bone regenerate formed but only at the host fragment along the vector of traction. With a 14-21 day latency, typical bone regenerate formed using either

[2] Примеч. ред. Эксперименты на животных с перемещением ауто-, алло-, ксенотрансплантатов и металлических конструкций для формирования дистракционного регенерата выполнены в РНЦ "ВТО" еще в 70-80-х гг.