Metadata of the chapter that will be visualized online

Chapter Title	Computer-Assisted External Fixation for Aesthetic-Changing Lower Limb Shape	
Copyright Year	2014	
Copyright Holder	Springer International Publishing Switzerland	
Corresponding Author	Family Name	**Kulesh**
	Particle	
	Given Name	**Pavel**
	Suffix	
	Organization	Vreden Russian Research Institute of Traumatology and Orthopedics
	Address	St. Petersburg, Russia
	Email	Kulesh_Pavel@mail.ru
Corresponding Author	Family Name	**Solomin**
	Particle	
	Given Name	**Leonid**
	Suffix	
	Organization	Vreden Russian Research Institute of Traumatology and Orthopedics
	Address	St. Petersburg, Russia
	Organization	St. Petersburg State University
	Address	St. Petersburg, Russia
	Email	solomin.leonid@gmail.com
Abstract	This is an example of preoperative planning and operative treatment for aesthetic changing of lower limb shape using external fixation. In this case, we performed gradual correction via a computer-assisted hexapod – Ortho-SUV Frame. Module transformation (removing of struts and internal half rings) provided opportunity to have patient stand with both legs together. This was helpful for evaluating clinical alignment and appearance.	

Limb Lengthening and Reconstruction Surgery Case Atlas
DOI 10.1007/978-3-319-02767-8_213-1

Computer-Assisted External Fixation for Aesthetic-Changing Lower Limb Shape

Pavel Kulesh[a]* and Leonid Solomin[a,b]*
[a]Vreden Russian Research Institute of Traumatology and Orthopedics, St. Petersburg, Russia
[b]St. Petersburg State University, St. Petersburg, Russia

Abstract

This is an example of preoperative planning and operative treatment for aesthetic changing of lower limb shape using external fixation. In this case, we performed gradual correction via a computer-assisted hexapod – Ortho-SUV Frame. Module transformation (removing of struts and internal half rings) provided opportunity to have patient stand with both legs together. This was helpful for evaluating clinical alignment and appearance.

1 Brief Clinical History

This female 31 y.o. came to Vreden Russian Research Institute of Traumatology and Orthopedics on April 08, 2012, having complaint of bow legs. She has been troubled by her alignment since she was a teenager.

2 Preoperative Clinical Photos and Radiographs

See Fig. 1.

3 Preoperative Problem List

The patient was unhappy with her lower limb shape: gap between knee joints, concave lower leg internal contour, and curved external contour.

Pathological changes of hip, knee, and ankle joints using physical and ultrasound examination and MRI were not revealed.

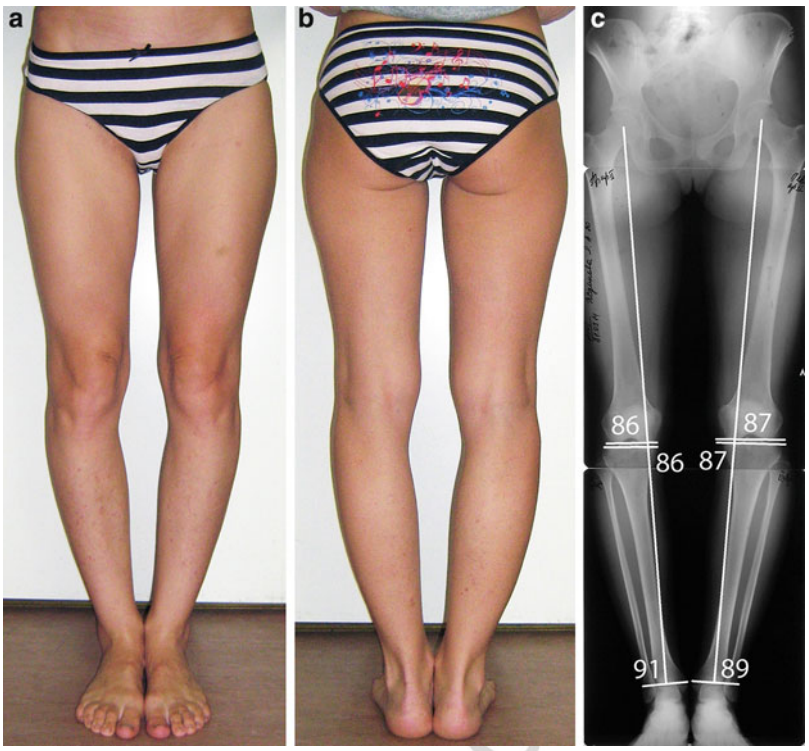
Bilateral bow legs without pain.

4 Treatment Strategy

The strategy was chosen according to the complexity of correction planned: valgization and medialization of the distal part of the tibia and tibia lengthening to pull the fibula distally. We planned to carry out three types of bone fragment moving. To simplify this procedure, software-

*Email: Kulesh_Pavel@mail.ru
*Email: solomin.leonid@gmail.com

Limb Lengthening and Reconstruction Surgery Case Atlas
DOI 10.1007/978-3-319-02767-8_213-1



Q1 **Fig. 1** (**a**) Front view showing bow leg alignment. There is a 5 cm gap between the legs on the level of the knee joints and 8 cm gap between the legs on the level of the proximal third of the shank. (**b**) Behind view showing bow leg alignment. (**c**) Standing X-ray showing bilateral medial mechanical axis deviation

based Ortho-SUV Frame (http://ortho-suv.org) was chosen. After deformity correction, the modular transformation of the external fixation device can be done.

5 Basic Principles

1. The use of external fixation provides possibility of low-traumatic surgery, avoiding large incision and opening the bone fragments.
2. The use of computer-assisted Ortho-SUV Frame provides precise, one-step gradual deformity correction.

6 Images During Treatment

See Fig. 2.

7 Technical Pearls

The assembly of the external frames provided stable fixation of the bone fragments and possibility of modular transformation. The assemblies used according to Method of Unified Designation of External Fixation (MUDEF: http://ortho-suv.org/index.php?option=com_content%26view=article%26id=127%26Itemid=93%26lang=en) are the following (identical for both lower legs):

Limb Lengthening and Reconstruction Surgery Case Atlas
DOI 10.1007/978-3-319-02767-8_213-1

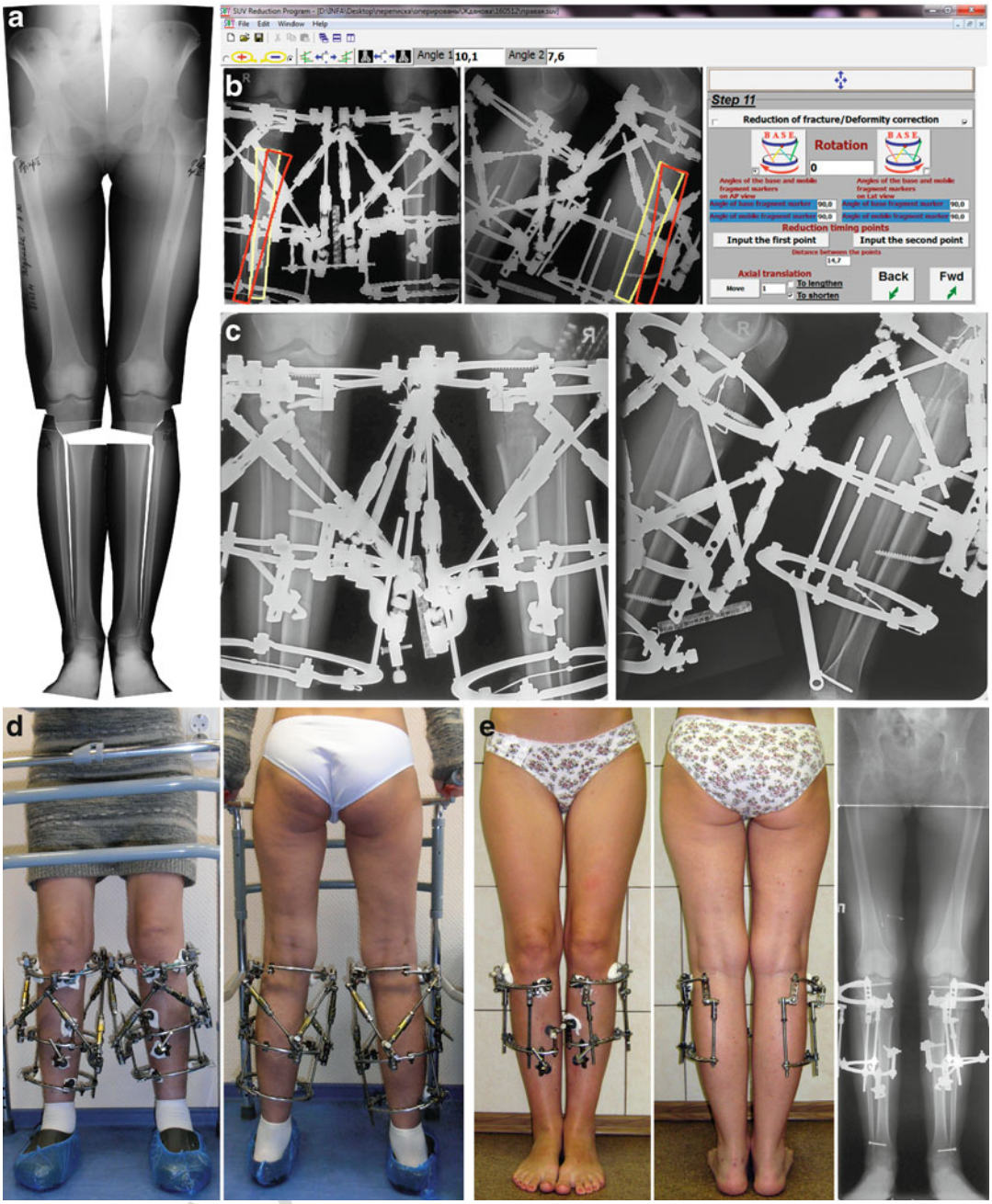


Fig. 2 (**a**) Preoperative planning. To achieve the desired result, we planned to carry out lengthening of the tibia of 2 cm, medialization of the distal part of the tibia of 10 mm, and valgization of 7°. (**b**) The Ortho-SUV software window at step 11: the deformities correction planning. The *yellow* bone contour indicated the initial mobile (corresponding) fragment position. The *red* bone contour created by the software indicates the final position of the mobile bone fragment. The same calculation was done for the *left* lower leg. (**c**) Radiographs after correction by Ortho-SUV. (**d**) Photos after correction. (**e**) Photos and radiographs after the modular transformation. Removing of internal half rings and struts provided the opportunity for the patient to stand with legs together which is a more accurate indication of final appearance

$$\frac{\mathrm{I},9,90;\ \mathrm{I},\mathbf{3}-9;\ \mathrm{II},1,90}{140}\ -\ \text{Ortho-SUV}\ -\ \frac{\mathrm{IV},2,90;\ \mathrm{VI},12,70}{140}-\frac{\mathrm{VII}(\mathbf{8}-2)8-2}{140}$$

Limb Lengthening and Reconstruction Surgery Case Atlas
DOI 10.1007/978-3-319-02767-8_213-1

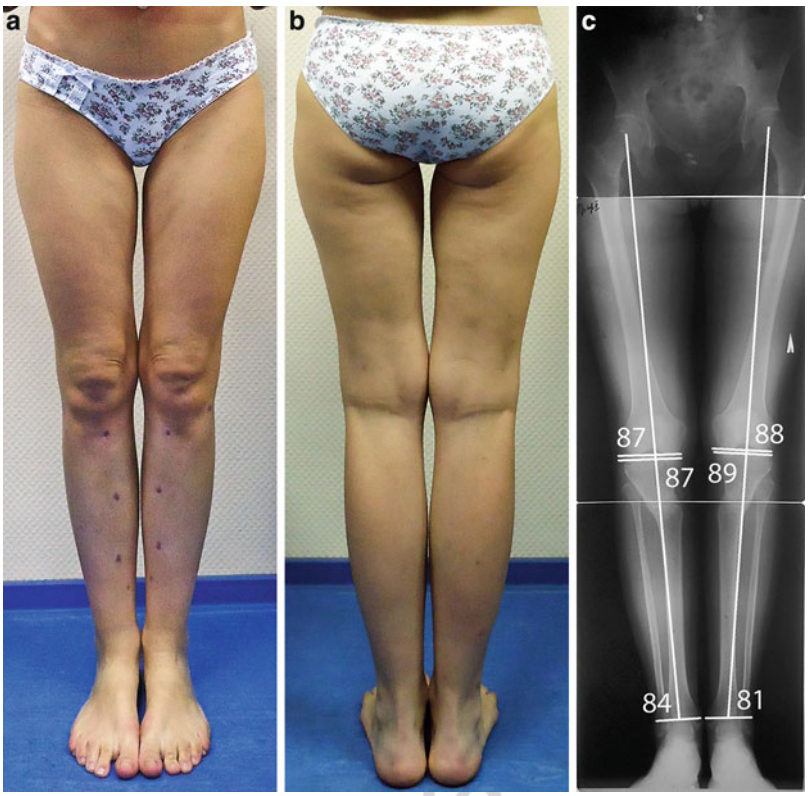


Fig. 3 (**a**–**c**) Photos and radiographs 1 month after removal of the external fixation frames showing normal alignment. There is no mechanical axis deviation noted

- Use of module transformation of the circular external frame decreases the bulkiness of the frames:

$$\frac{\text{I}, 9, 90;\ \text{II}, 1, 90}{1/2 \quad 140} - \frac{\text{IV}, 2, 90;\ \text{VI}, 12, 70}{1/2 \quad 140}$$

8 Outcome Clinical Photos and Radiographs

See Fig. 3.

9 Avoiding and Managing Problems

The correction of the deformities was done gradually. Use of a structure at risk point helped determine optimal speed of correction, prevented nerve or vascular disorders, and helped with optimal callus formation.

Active antibiotic therapy and close method of pin-site management were used to prevent infectious complications.

Distal tibiofibular syndesmosis was fixed by screws to prevent gap after frame module transformation and removal of the tibiofibular wire.

Limb Lengthening and Reconstruction Surgery Case Atlas
DOI 10.1007/978-3-319-02767-8_213-1

10 Cross-References

- Computer Assisted External Fixation and then Nailing at Both Lower Legs Non-Unions Accompanied with Complex Deformities
- Computer Assisted External Fixation at Femur two-Level Posttraumatic Complex Deformity
- Computer Assisted External Fixation at Femur Malunion Accompanied With Complex Deformity
- Spondyloepiphyseal Dysplasia Treated by Bi-lateral Proximal Tibial Osteotomy Followed by Gradual Deformity Correction

References and Suggested Reading

Artemiev AA, Mirzoyan AE (2001) Ilizarov technique and aesthetic surgery of legs. In: The 2nd international meeting of the A.S.A.M.I.: Abstract. Book, Rome, p 28

Paley D (2003) Principles of deformity correction. Springer, New York, 806

Paley D (2011) History and science behind the six-axis correction external fixation devices in orthopaedic surgery. Oper Tech Orthop 21:125–128, © 2011 Elsevier Inc

Solomin LN (2008) The basic principles of external fixation using the Ilizarov device. Springer, Milano, 357

Limb Lengthening and Reconstruction Surgery Case Atlas
DOI 10.1007/978-3-319-02767-8_213-1

Index Terms:

Limb Lengthening and Reconstruction Surgery Case Atlas
DOI 10.1007/978-3-319-02767-8_213-1

Author Queries

Query Refs.	Details required
Q1	Please confirm if all figure captions are okay.
Q2	Please check if inserted publisher location for Solomin (2008) is okay.