Ex. 127. FITBONE®

General description* of the task

To stretch out the bone during the treatment after a fracture, the very difficult constructions (fig. 19.12) were used, which pained the patient and sometimes not guarantied getting right shape. What could be done?

Here we reinvent this invention to extract from it the logic of applying the MAI and TRIZ navigators according to work** where MAI-structure and TRIZ tools were efficiently applied.

This is one of the solutions where the TRIZ models are shown up very clear.

For educational purpose we use here some additional interpretations and models as usual for every reinventing.

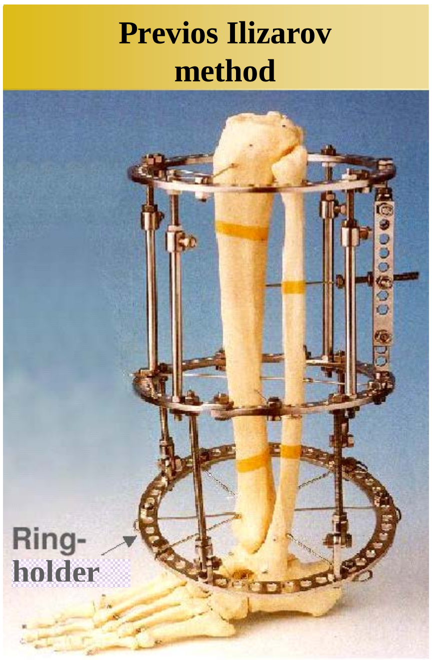

fig. 19.12. Well known Ilizarov holder to stretch the bone

DIAGNOSTICS

The initial construction of bone holder and stretcher consists from the rods connected in single whole with a help of the rings which are adjusted to correct state while the rods are little by little made longer.

The gaps in the bone after the fracture are fulfilled with the regenerative bone fragments taken from patient.

Though this method had been the most effective for the decades, some problems were occurred.

Because of complexity of construction the holder is difficult adjusted. It leads to some mistakes which in their turn lead to incorrect form of the bone after the stretching.

The complexity leads also to long time of treatment while the open wound could cause infection.

In any case this construction pains and prevents to patient to wash, to walk etc.

---

* Registered mark, pictures and initial materials are the property of the Wittenstein intens® (Intelligent Encapsulated Systems) Ltd. and were put by proprietor to the author for publishing in this book in the notation used here.

** Dr. T.Bayer: TRIZ in der WITTENSTEIN AG. – 4th European TRIZ-Congress, 2005; additional sources: magazine “DER SPIEGEL”, No. 30, June 2005 and www.fitbone.de.

Dr. T.Bayer was awarded the Modern TRIZ certificate in 2002.

REDUCTION

Operative zone and the resources

OZ: the bone. **OT:** time for stretching.

Inductor and receptor

Inductor - rod stretching construction. **Receptor** - the bone.

Technical contradictions for method CICO

The problem is very difficult and could be described with a group of different contradictions. After that we could apply the method CICO.

Nr. TC	**Effect, Condition, Object**						
	holding the bone for stretching						
	(+) - factor			**(-) - factor**			
1	infections; movement restriction and sleep disturbance	14	internal damaging factors	long time with open wound	23	functional time of the moveable object	07, 21, 31, 38
2	infections; movement restriction and sleep disturbance	14	internal damaging factors	applying the sizeable strengths	30	force	01, 03, 04, 17
3	to accelerate the treatment	01	productivity	to simplify the adjustment	10	ease of use	03, 04, 08, 34
4	infections; movement restriction and sleep disturbance	13	external damaging factors	to keep the construction in working state	23	functional time of the moveable object	04, 07, 21, 38
CICO ranking: 04^3, 03^2, 07^2, 21^2, 38^2, 01, 08, 17, 31, 34							

fig. 19.13. Selected technical contradictions for problem modeling according to CICO

Physical contradiction

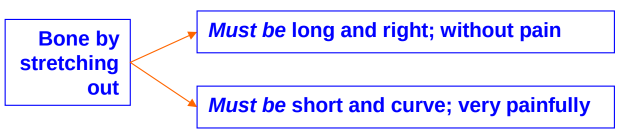

fig. 19.14. Graphic model of physical contradiction for problem

Ideal Functional Result

Macro-FIM: X-resource, without producing the inadmissible effects and without complicating a system, ensures together with other existing resources

[*the right shaping the bone (with less pain, restrictions and disturbance)*].

TRANSFORMATION We could see that the spatial resources are the most interested here. Let us consider additionally the combination of fundamental transformations with specialized ones.

fundamental transformation	connection to As-navigators
1 separation of the conflicting properties in **space**	**05 separation:** remove the disruptive part, emphasize the part needed. **10 copying:** use of simplified and inexpensive copies. **19 transition into another dimension:** increase the freedom of an object, use construction in several layers, use lateral and other surfaces. **22 spherical-shape:** transition to curved surfaces and shapes, use of wheels, balls, or springs. **24 asymmetry:** transition to asymmetrical shapes, increase asymmetry. **25 use of flexible covers and thin layers:** use flexible covers and thin layers instead of normal constructions. **34 matryoshka:** store an object in another one in stages, place an object in the hollow space of another one.

fig. 19.15. Combination of fundamental transformations with specialized ones.

Analysis of navigators and idea generating could be made as following.

According to navigator 05 it is possible to apply new X-resource as more close to bone (operative zone) as possible due to eliminating old difficult solution (long-distance positioning) and inventing new one (short-distance positioning).

According to navigator 10 it is possible to apply some X-resource like copy of bone in operative zone (?).

Navigator 19 could be interpreted like recommendation to consider not only outside but also inside surfaces of bone (operative space! How is it possible?).

From remaining navigators the navigator *34 matryoshka* looks very suitable to develop new construction due the possible idea to put some stretching X-resource just in the bone hole (!?).

In a similar manner let us study the selected navigators from resulting cluster of CICO. The composition “portrait” of a solution to be:

04 replacement of mechanical matter – Yes! We have to use electrical, magnetic, or electromagnetic fields for control new X-resource in operative zone near or inside the bone!;

07 dynamization – Yes! We have to use the characteristics of an X-resource (inductor) and the bone (receptor) changeable to optimize increasing the length of bone during stretching!

08 periodic action – OK! May be we could use transition from a continuous function to a periodic one (impulse) to get opportunity of little by little increasing the bone without intolerable pain?

17 use of composite materials – Yes, we have to think about materials which are compatible with an organism;

31 use of porous materials – Interesting! It looks like recommendation to use supplementary porous elements (inserts, coverings, etc.) to set new X-resource into the bone; and it is very similar to matryoshka-navigator;

34 matryoshka (nested doll) – Really, it is an idea for solution! X-resource could be a construction inside the bone!

Taking in account the table on fig. 19.15 we could see that navigator *34 matryoshka* is very promising.

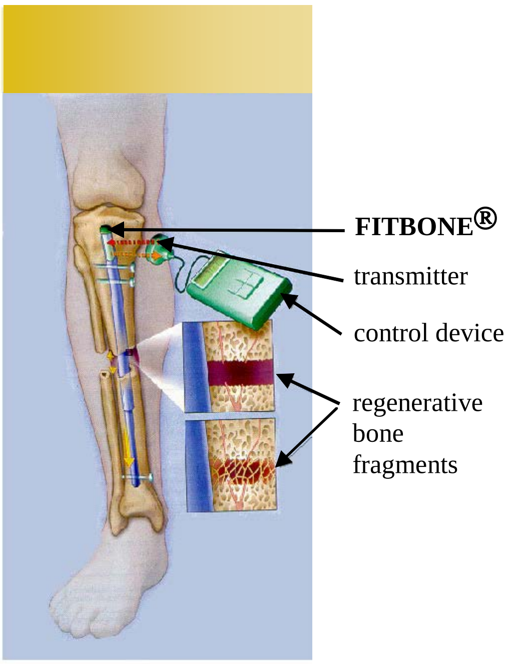

fig. 19.16. New solution on the base of navigators 04, 07 and 34

Together with this the navigators 04, 07 and 31 look as very perspective to generate radical new ideas based on the making the construction inside the bone!
Main resulting idea (fig. 19.16): to realize the stretching construction like special controlled rod (marked at the picture as FITBONE®), put into the bone and growing on the length due the embedded micro-motor and miniature transmission.

VERIFICATION

Both technical contradiction and physical contradiction are eliminated.

The strong super-effects: painless, very reliable stretching and shaping.

From materials of the authors we know that the growth of the bone could be increased by 1mm a day. The patient in short period could work, wash and sleep.

To finish this part author has to say that the very special knowledge is necessary for solving to any difficult problems. To solve first problem author had co-operated with the specialists of the Korean company produced the machines for liquid crystal screen manufacturing. To solve second problem inventors and bio-mechanical engineers had co-operated with the doctors who are specialists in surgery and prosthesis.