LEONARDO DA VINCI

Transfer of Innovation

PROJECT

"Osteosynthesis for Surgical Management of Fractures for Orthopedic Surgeons and Biomedical Engineers"

- OrthoBioMed –

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NEED ANALYSIS REPORT

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Introduction

To respond to the increasingly stringent demands of better trained professionals in osteosynthesis it is essential that surgeons, biomedical engineers and residents can count on one hand on the latest knowledge in the art of biomechanics and application of implants and on another hand to upgrade their education with the objective to refine and adapt surgical techniques. Towards this preliminary need analysis the OrthoBioMed project has been designed.

This report identifies and analyses the specific requirements of orthopaedists, surgeons, medical staff and medicine engineers with regard to the content and techniques for delivery of training materials in the OrthoBioMed system in each partner country. The students in medical engineering and their teachers are also target group in this project. They need courses providing knowledge about the subject of the devices they are developing.

Because this project was designed to meet the specific training needs of the medical staff and medicine engineers in Bulgaria and Greece, we decided to collect all reports in one document and to conclude the report with the competence matrix for the courses with the learning outcomes for knowledge, skills and competences for each of the courses respecting the identified needs.

Project survey results by the Institute of biomechanics of Valencia

Introduction

This report describes the results obtained within the field study carried out into the first step of the ***ORTHOBIOMED*** project. Users of different professional profiles pertaining to Orthopaedic surgeon, Mechanical engineer, Resident in orthopaedics and Medical staff, in order to detect their learning necessities, fulfilled specific questionnaires.

The **specifics objectives** of the study have been:

- To know the socio-demographic and academic profile of the professionals of the trauma surgery and the fracture biomechanics areas.
- To identify the knowledge level at the job incorporation time and after some years of experience.
- To know if the formation received by these professionals was adequate.
- To value the possibility of carrying out a complementary formation.
- To identify the main learning areas for each profile.
    - Biomedical engineers
    - Residents and orthopaedic surgeons
- To provide information useful to update the e-learning materials adapted to the necessities of the sector in Bulgaria, Greece and Spain

Parameters of the study

In the following table, the descriptive parameters of the survey are resumed:

Sample Characteristics	• Orthopaedic surgeons • Residents in Orthopaedics. • Mechanical engineer • Other professionals linked to the i orthopaedics's distribution and development
Total size of the sample	61 participants: 51 men y 10 women
Sample description	Participant entities: • TECHNICAL UNIVERSITY OF SOFIA • INSTITUTO DE BIOMECÁNICA DE VALENCIA • MEDICAL UNIVERSITY PLOVDIV • DEPARTMENT OF ORTHOPAEDIC SURGERY AND TRAUMATOLOGY OF UNIVERSITY OF THESSALIA
Country Context	European technology institutes and companies
Temporal Context	The period of the data collection was January-February 2014.
Data collection	Auto-fulfilled questionnaire

Table 1. Descriptive parameters.

Analysis and conclusions

This section reports the most significant data regarding formation about Orthopaedic surgery and spine biomechanics.

The sample was composed by surgeons and professionals of the orthopaedic development and distribution areas. The majority of these professionals have between 1 and 5 years of experience. Men represent the 83.6% of the category. The main age range of the participants was between 25 and 35 years old.

Regarding the academic formation of the sample, the survey emphasizes that 96.8% are highly graduates, with a 72.6% coming from medicine studies and 16.1% from engineering.

At the job incorporation time, 50% of the subjects judge their formation as appropriate or really appropriate. The quasi totality of them (93.3%) considers that the formation remains appropriate or really appropriate, after some years of experience in this field.

The majority of the sample, concretely the 54.2%, attended complementary formation during the two last years.

The formation actions were subsidized and private. The financing organisms were generally health ministries, universities or hospitals. The survey also emphasizes a high level of other university formations and high percentage of PhD (26.2%), Postgraduate courses (28.6%) and Masters (19%).

The on-line modality is considered appropriate or really appropriate by the 90.7% of the sample, to receive a formation in the field of osteosynthesis.

About how many hours of training are necessary per year for a worker in your position, the 48.3% of the sample prefer less than 50 hours (complementary formation courses, seminars and conferences), the 35% Between 50 and 100 hours (Postgraduate courses) and the 16.7% More than 100 hours (Postgraduate and master).

Concerning the interests of each professional profile, the survey emphasizes the main following learning areas:

- All the proposed contents are considered as interesting (only “Legal aspects of surgical material” are lower than 60%), and all are evaluated as important for the work performance. The actual knowledge declared by the subjects regarding the learning contents is medium.
- Considering the whole consortium, the main learning contents are the following*: Bones remodelling. Mechanical adaptation, orthopaedic fracture reparation systems, biomechanical study of the fracture, osteosynthesis mistakes and Bone biomechanics.*
- The main contents requested by the sanitary profile are the following: *Orthopaedic fracture reparation systems, Early complications, Results monitoring, Fracture stability,*

Fracture's anatomic reduction, Consolidation delays (Pseudoarthrosis) and Osteosynthesis mistakes.

- The main contents requested by the technical profile are the following: *Bones remodelling. Mechanical adaptation, Biomaterials, Biomechanical study of the fracture, Orthopaedic fracture reparation systems and Surgical fracture reparation systems.*
- About all areas the sample think that is interesting:
    - hand fractures, 91.4% of the sample
    - backbone fractures, 75.4% of the simple
    - implants to fix hand fractures, 93.1% of the simple
    - implant to fix backbone fractures, 77.6% of the simple
    - Others: Pelvic fractures, long bones fractures, all kind of fractures, loer limb, shinbone, knee, legs, foot and ankle, dental implants, lower and upper extremities.

The main benefits of this kind of formation identified by the participants are resumed in the following points:

- To increase my knowledge (82.8%) and to increase my professional skills (55.2%)
- Interesting practical contents and easiness and usability in the course access
- The course length should be around 20-40 hours.
- Economic cost should be inferior to 100 euros for Bulgaria and Greece users, and between 200 and 300 euros for Spanish users.

Appendix

The following tables detail the results of the study showing the different knowledge areas evaluated during the survey.

The table A1 resumes the importance within the work performance, the level of knowledge and the interest related to each **learning contents area for the whole sample**:

% TOTAL	IMPORTANCE OF THIS AREA FOR YOUR JOB			KNOWLEDGE LEVEL			FORMATION INTEREST	
	NULL	MEDIUM	INDISPENSABLE	BASIC	MEDIUM	WIDE	I WOULD LIKE TO BE TRAINED	I WOULD NOT LIKE TO BE TRAINED
1. Bone biomechanics	0.0% (0)	29.3% (17)	**70.7%** (41)	10.3% (6)	**65.5%** (38)	24.1% (14)	**96.6%** (56)	3.4% (2)
2. Fracture's anatomic reduction	3.5% (2)	31.6% (18)	**64.9%** (37)	12.3% (7)	**57.9%** (33)	29.8% (17)	**88.2%** (45)	11.8% (6)
3. Vascularization conservation	10.5% (6)	35.1% (20)	**54.4%** (31)	28.1% (16)	**43.9%** (25)	28.1% (16)	**68.6%** (35)	31.4% (16)
4. Fragments compression	8.8% (5)	35.1% (20)	**56.1%** (32)	22.8% (13)	38.6% (22)	38.6% (22)	**83.0%** (44)	17.0% (9)
5. Fracture stability	1.7% (1)	31.0% (18)	**67.2%** (39)	6.9% (4)	**55.2%** (32)	37.9% (22)	**90.6%** (48)	9.4% (5)
6. Orthopaedic fracture reparation systems	3.4% (2)	22.4% (13)	**74.1%** (43)	7.0% (4)	**57.9%** (33)	35.1% (20)	**96.4%** (54)	3.6% (2)
7. Surgical fracture reparation systems	1.7% (1)	29.3% (17)	**69.0%** (40)	10.3% (6)	**55.2%** (32)	34.5% (20)	**98.2%** (56)	1.8% (1)
8. Legal aspects of surgical material	8.8% (5)	**47.4%** (27)	43.9% (25)	41.4% (24)	**43.1%** (25)	15.5% (9)	**76.8%** (43)	23.2% (13)
9. Fractures classification	5.2% (3)	34.5% (20)	**60.3%** (35)	8.6% (5)	**55.2%** (32)	36.2% (21)	**80.8%** (42)	19.2% (10)
10. Biomechanical study of the fracture	1.7% (1)	25.9% (15)	**72.4%** (42)	12.1% (7)	**62.1%** (36)	25.9% (15)	**94.8%** (55)	5.2% (3)
11. Preoperatory surgical planning	7.0% (4)	29.8% (17)	**63.2%** (36)	19.0% (11)	**50.0%** (29)	31.0% (18)	**82.7%** (43)	17.3% (9)

% TOTAL	IMPORTANCE OF THIS AREA FOR YOUR JOB			KNOWLEDGE LEVEL			FORMATION INTEREST	
	NULL	MEDIUM	INDISPENSABLE	BASIC	MEDIUM	WIDE	I WOULD LIKE TO BE TRAINED	I WOULD NOT LIKE TO BE TRAINED
12. Early complications	7.0% (4)	28.1% (16)	**64.9%** (37)	24.1% (14)	**39.7%** (23)	36.2% (21)	**72.5%** (37)	27.5% (14)
13. Consolidation delays (Pseudoarthrosis)	6.9% (4)	29.3% (17)	**63.8%** (37)	20.7% (12)	**44.8%** (26)	34.5% (20)	**82.7%** (43)	17.3% (9)
14. Results monitoring	5.2% (3)	29.3% (17)	**65.5%** (38)	19.0% (11)	**53.4%** (31)	27.6% (16)	**84.9%** (45)	15.1% (8)
15. Osteosynthesis mistakes	3.4% (2)	25.9% (15)	**70.7%** (41)	12.1% (7)	**62.1%** (36)	25.9% (15)	**91.1%** (51)	8.9% (5)
16. Controversies and new trends	3.5% (2)	31.6% (18)	**64.9%** (37)	24.1% (14)	**56.9%** (33)	19.0% (11)	**98.2%** (56)	1.8% (1)
17. Bones remodelling. Mechanical adaptation	1.8% (1)	22.8% (13)	**75.4%** (43)	15.5% (9)	**50.0%** (29)	34.5% (20)	**92.7%** (51)	7.3% (4)
18. Bone grafts	5.2% (3)	37.9% (22)	**56.9%** (33)	19.3% (11)	**57.9%** (33)	22.8% (13)	**84.9%** (45)	15.1% (8)
19. Biomaterials	3.4% (2)	31.0% (18)	**65.5%** (38)	20.7% (12)	**51.7%** (30)	27.6% (16)	**96.5%** (55)	3.5% (2)
20. Bone tissue engineering	17.2% (10)	32.8% (19)	**50.0%** (29)	33.3% (19)	**49.1%** (28)	17.5% (10)	**85.5%** (47)	14.5% (8)

Table A1. Interest of the learning areas for the whole polled.

The table A2 resumes the importance within the work performance, the level of knowledge and the interest related to each **learning contents area for the sanitary profile**:

% TOTAL	IMPORTANCE OF THIS AREA FOR YOUR JOB			KNOWLEDGE LEVEL			FORMATION INTEREST	
	NULL	MEDIUM	INDISPENSABLE	BASIC	MEDIUM	WIDE	I WOULD LIKE TO BE TRAINED	I WOULD NOT LIKE TO BE TRAINED
1. Bone biomechanics	0.0% (0)	28.9% (13)	**71.1%** (32)	11.1% (5)	**66.7%** (30)	22.2% (10)	**95.6%** (43)	4.4% (2)
2. Fracture's anatomic reduction	2.2% (1)	22.2% (10)	**75.6%** (34)	2.2% (1)	**60.0%** (27)	37.8% (17)	**89.7%** (35)	10.3% (4)
3. Vascularization conservation	2.2% (1)	31.1% (14)	**66.7%** (30)	8.9% (4)	**55.6%** (25)	35.6% (16)	**84.6%** (33)	15.4% (6)
4. Fragments compression	4.4% (2)	31.1% (14)	**64.4%** (29)	6.7% (3)	44.4% (20)	**48.9%** (22)	**87.8%** (36)	12.2% (5)
5. Fracture stability	0.0% (0)	24.4% (11)	**75.6%** (34)	4.4% (2)	46.7% (21)	**48.9%** (22)	**90.0%** (36)	10.0% (4)
6. Orthopaedic fracture reparation systems	4.4% (2)	17.8% (8)	**77.8%** (35)	6.7% (3)	**57.8%** (26)	35.6% (16)	**97.7%** (42)	2.3% (1)
7. Surgical fracture reparation systems	2.2% (1)	24.4% (11)	**73.3%** (33)	11.1% (5)	**51.1%** (23)	37.8% (17)	**97.7%** (43)	2.3% (1)
8. Legal aspects of surgical material	8.9% (4)	42.2% (19)	**48.9%** (22)	33.3% (15)	**48.9%** (22)	17.8% (8)	**83.7%** (36)	16.3% (7)
9. Fractures classification	2.2% (1)	26.7% (12)	**71.1%** (32)	2.2% (1)	**51.1%** (23)	46.7% (21)	**84.6%** (33)	15.4% (6)
10. Biomechanical study of the fracture	2.2% (1)	24.4% (11)	**73.3%** (33)	8.9% (4)	**68.9%** (31)	22.2% (10)	**95.6%** (43)	4.4% (2)
11. Preoperatory surgical planning	4.4% (2)	22.2% (10)	**73.3%** (33)	6.7% (3)	**53.3%** (24)	40.0% (18)	**87.5%** (35)	12.5% (5)

% TOTAL	IMPORTANCE OF THIS AREA FOR YOUR JOB			KNOWLEDGE LEVEL			FORMATION INTEREST	
	NULL	MEDIUM	INDISPENSABLE	BASIC	MEDIUM	WIDE	I WOULD LIKE TO BE TRAINED	I WOULD NOT LIKE TO BE TRAINED
12. Early complications	0.0% (0)	22.2% (10)	**77.8%** (35)	8.9% (4)	44.4% (20)	**46.7%** (21)	**84.6%** (33)	15.4% (6)
13. Consolidation delays (Pseudoarthrosis)	0.0% (0)	24.4% (11)	**75.6%** (34)	6.7% (3)	**48.9%** (22)	44.4% (20)	**90.0%** (36)	10.0% (4)
14. Results monitoring	2.2% (1)	20.0% (9)	**77.8%** (35)	11.1% (5)	**55.6%** (25)	33.3% (15)	**95.0%** (38)	5.0% (2)
15. Osteosynthesis mistakes	2.2% (1)	22.2% (10)	**75.6%** (34)	8.9% (4)	**60.0%** (27)	31.1% (14)	**93.0%** (40)	7.0% (3)
16. Controversies and new trends	4.4% (2)	26.7% (12)	**68.9%** (31)	20.0% (9)	**57.8%** (26)	22.2% (10)	**97.7%** (43)	2.3% (1)
17. Bones remodelling. Mechanical adaptation	2.3% (1)	25.0% (11)	**72.7%** (32)	15.6% (7)	57.8% (26)	**26.7%** (12)	**93.0%** (40)	7.0% (3)
18. Bone grafts	6.7% (3)	24.4% (11)	**68.9%** (31)	17.8% (8)	**53.3%** (24)	28.9% (13)	**90.2%** (37)	9.8% (4)
19. Biomaterials	4.4% (2)	35.6% (16)	**60.0%** (27)	22.2% (10)	**55.6%** (25)	22.2% (10)	**97.7%** (43)	2.3% (1)
20. Bone tissue engineering	8.9% (4)	37.8% (17)	**53.3%** (24)	25.0% (11)	**56.8%** (25)	18.2% (8)	**97.6%** (41)	2.4% (1)

Table A2. Interest of the learning areas for the sanitary profile.

The table A3 resumes the importance within the work performance, the level of knowledge and the interest related to each **learning contents area for the technical profile**:

% TOTAL	IMPORTANCE OF THIS AREA FOR YOUR JOB			KNOWLEDGE LEVEL			FORMATION INTEREST	
	NULL	MEDIUM	INDISPENSABLE	BASIC	MEDIUM	WIDE	I WOULD LIKE TO BE TRAINED	I WOULD NOT LIKE TO BE TRAINED
1. Bone biomechanics	0.0% (0)	**57.1%** (4)	42.9% (3)	0.0% (0)	**71.4%** (5)	28.6% (2)	**100.0%** (7)	0.0% (0)
2. Fracture's anatomic reduction	0.0% (0)	**85.7%** (6)	14.3% (1)	42.9% (3)	**57.1%** (4)	0.0% (0)	**100.0%** (7)	0.0% (0)
3. Vascularization conservation	**71.4%** (5)	28.6% (2)	0.0% (0)	**100.0%** (7)	0.0% (0)	0.0% (0)	0.0% (0)	**100.0%** (7)
4. Fragments compression	28.6% (2)	**71.4%** (5)	0.0% (0)	**85.7%** (6)	14.3% (1)	0.0% (0)	**71.4%** (5)	28.6% (2)
5. Fracture stability	0.0% (0)	**71.4%** (5)	28.6% (2)	0.0% (0)	**100.0%** (7)	0.0% (0)	**85.7%** (6)	14.3% (1)
6. Orthopaedic fracture reparation systems	0.0% (0)	42.9% (3)	**57.1%** (4)	0.0% (0)	42.9% (3)	**57.1%** (4)	**85.7%** (6)	14.3% (1)
7. Surgical fracture reparation systems	0.0% (0)	42.9% (3)	**57.1%** (4)	0.0% (0)	**71.4%** (5)	28.6% (2)	**100.0%** (7)	0.0% (0)
8. Legal aspects of surgical material	14.3% (1)	**85.7%** (6)	0.0% (0)	**100.0%** (7)	0.0% (0)	0.0% (0)	14.3% (1)	**85.7%** (6)
9. Fractures classification	0.0% (0)	**100.0%** (7)	0.0% (0)	14.3% (1)	**85.7%** (6)	0.0% (0)	**71.4%** (5)	28.6% (2)
10. Biomechanical study of the fracture	0.0% (0)	28.6% (2)	**71.4%** (5)	0.0% (0)	**57.1%** (4)	42.9% (3)	**100.0%** (7)	0.0% (0)
11. Preoperatory surgical planning	0.0% (0)	**71.4%** (5)	28.6% (2)	42.9% (3)	**57.1%** (4)	0.0% (0)	**85.7%** (6)	14.3% (1)

% TOTAL	IMPORTANCE OF THIS AREA FOR YOUR JOB			KNOWLEDGE LEVEL			FORMATION INTEREST	
	NULL	MEDIUM	INDISPENSABLE	BASIC	MEDIUM	WIDE	I WOULD LIKE TO BE TRAINED	I WOULD NOT LIKE TO BE TRAINED
12. Early complications	42.9% (3)	**57.1%** (4)	0.0% (0)	**85.7%** (6)	14.3% (1)	0.0% (0)	0.0% (0)	**100.0%** (7)
13. Consolidation delays (Pseudoarthrosis)	42.9% (3)	**57.1%** (4)	0.0% (0)	**85.7%** (6)	14.3% (1)	0.0% (0)	33.3% (2)	**66.7%** (4)
14. Results monitoring	28.6% (2)	**71.4%** (5)	0.0% (0)	**71.4%** (5)	28.6% (2)	0.0% (0)	28.6% (2)	**71.4%** (5)
15. Osteosynthesis mistakes	0.0% (0)	**57.1%** (4)	42.9% (3)	14.3% (1)	**85.7%** (6)	0.0% (0)	**85.7%** (6)	14.3% (1)
16. Controversies and new trends	0.0% (0)	**57.1%** (4)	42.9% (3)	28.6% (2)	**71.4%** (5)	0.0% (0)	**100.0%** (7)	0.0% (0)
17. Bones remodelling. Mechanical adaptation	0.0% (0)	0.0% (0)	**100.0%** (7)	0.0% (0)	14.3% (1)	**85.7%** (6)	**100.0%** (7)	0.0% (0)
18. Bone grafts	0.0% (0)	**100.0%** (7)	0.0% (0)	0.0% (0)	**100.0%** (7)	0.0% (0)	**71.4%** (5)	28.6% (2)
19. Biomaterials	0.0% (0)	0.0% (0)	**100.0%** (7)	0.0% (0)	42.9% (3)	**57.1%** (4)	**85.7%** (6)	14.3% (1)
20. Bone tissue engineering	0.0% (0)	0.0% (0)	0.0% (0)	**71.4%** (5)	28.6% (2)	0.0% (0)	0.0% (0)	**100.0%** (7)

Table A3. Interest of the learning areas for the technical profile.

NEED ANALYSIS REPORT DONE BY THE DEPARTMENT OF ORTHOPAEDICS AND TRAUMATOLOGY, MEDICAL UNIVERSITY – PLOVDIV, BULGARIA

EXECUTIVE

This need analysis provides the analysis findings of a questionnaire answered from Bulgaian Orthopaedic Surgeons of different training and experience levels, on the topic of the Surgical Management of Fractures through fixation (Osteosynthesis) and the existing knowledge and potential training the Orthopaedic Surgeons need, in the frame of the OrthoBioMed project

INTRODUCTION

This report includes the following sections: background, specific purposes, limitations, questions, methods, samples, instrumentation, results, and recommendations.

The need analysis was conducted from the Department of Orthopaedics and Traumatology of the Medical University – Plovdiv, Bulgaria, and the questionnaire was answered from Bulgarian Orthopaedic Surgeons and Residents in Orthopaedics and Traumatology of different training and experience levels.

BACKGROUND

The present need analysis was done within the Lifelong Learning Program (LLP) – Leonardo da Vinci project, entitled "Osteosynthesis for Surgical Management of Fractures for Orthopedic Surgeons and Biomedical Engineers". Osteosynthesis is defined as surgical fixation of fractures after reduction with closed or open methods and is performed by every practising orthopaedic surgeon on a daily basis. The OrhoBioMed project lies within the scope of the LLP initiative goals as set by the European Community in an effort to support education and training, and enhance the development of skills across Europe. In specific, the aims of the project are:

- To identify and analyse the needs of biomedical labour market, of biomedical engineers, orthopaedic surgeons, managers, residents in the sector.
- To select and analyse the e-learning innovative content to meet these needs and upgrade the content with the new developments in the sector.
- To adapt, upgrade and implement the Osteoform e-learning materials to the legal framework, training system, and language in Bulgaria and Greece and to the needs of the target groups in all partner countries.

The aims of the project will be accomplished by developing and carrying out a combination of activities, starting by identifying the specific needs of the users in the health care sector. This is a very important and necessary first step of the whole project towards the realization of the next steps, with emphasis on proper material selection

and adaptation of new courses in a technically innovative performance support environment that can meet the real training needs of the medical staff.

Specific Purposes

The need analysis within the project activities intends to identify and analyze precise user requirements and real training needs of staff in the medical/paramedical sector on the field of fracture fixation (osteosynthesis). The goal of the analysis was first to confirm and clarify the existence of specific needs on innovative e-learning materials, special topics of interest, and problem-based learning skills in osteosynthesis. Next, the results of this task were "translated" and analyzed in a way so as to support the decision-making procedure for providing the best training framework and most appropriate modules to be adopted in the support environment. Consequently, the results will allow the development, adaptation and upgrade of any traditional and out-of-date material, tool, practice and platform to a more targeted, technically sophisticated and integrated e-learning process.

Limitations

Beyond inherent limitations of each tool used in the need analysis, professional, local medico-legal and social differences may have been underestimated. Although the sample was quite representative all the people that have been selected to take part in the survey were orthopaedic surgeons of different training and skills background and residents in orthopaedic surgery, but the specific contents of the survey could easily justify the targeted audience.

Questions

The addressed questions were very well understandable and offered multiple choice answers. The questionnaire was kindly prepared and offered to all Project Participants by IBV, Spain after a thorough discussion was held on the First Project Meeting in Sofia, Bulgaria.

Methods, Samples & Instrumentation

The ***methods*** and ***instrumentation*** used in this analysis were primarily surveys and interviews aiming at incorporating the opinions of different groups of professionals in the medical sector, after a careful review of the literature in the field of fracture fixation. The main approach used was interviews, during which a specific form of a 34-item, web-based questionnaire (same with the one given by the rest of the partners in the project) was used from the Bulgarian Orthopaedic Surgeons. The questionnaire focused on the knowledge already acquired in the fields of bone biology and biomechanics, fractures, and osteosynthesis and on the necessity of training in the respective fields. In particular, the respondents were medical doctors and residents, with the majority being orthopaedic surgeons. Surveys and interviews were conducted at the

Department of Orthopaedics and Traumatology of Medical University – Plovdiv, Bulgaria and took place in January and February, 2014 in Plovdiv, Bulgaria.

The ***sample*** was quite representative (22 people in total filled the questionnaire) and differed as far as of the specific major/discipline/area of work and interests, as well as seniority, age and gender. However, all the people but one that have been selected to take part in the survey were certified orthopaedic surgeons and residents in orthopaedic surgery . Those people were also selected after a careful analysis of the specific groups of potential targets that will benefit the most from the existence of the vocational learning environment that is to be developed. Interviews with the following groups of surgeons were conducted:

- Certified orthopaedic surgeons : 12 of 22 participants, the vast majority of them having more than 15 years of experience in orthopaedic surgery
- Residents in orthopaedics and traumatology: 8 of 22 participants
- Others: 1 of 22 participants
- Not completed survey: 1 of 22 participants.

17 of the 21 people who completed the questionnaire were male, and 4 were female, which is quite predictable, having in mind the majority of male doctors in orthopaedics and traumatology.

Variations in age are as follows: 25-35 years old – 11 participants; 36-46 years old – 5 participants; 46-55 years old – 5 participants; 56-65 years old – 1 participant.

RESULTS

The results of the specific need analysis carried out in Medical University – Plovdiv, Bulgaria provided the following observations:

- The majority of Bulgarian orthopaedic surgeons and residents find their ***training*** appropriate or really appropriate and have received training in their specific field in the last 2 years
- The majority of Bulgarian orthopaedic surgeons and residents considered the ***online training modality*** as appropriate or really appropriate and declared that less than 50 hours of training would be necessary.
- The majority of Bulgarian orthopaedic surgeons and residents considered their ***level of knowledge*** in the specific fields (bone biomechanics, vascularization, fracture classification, fracture fixation, reparation systems, complications etc) as intermediate, and would like to increase their information in the respective fields.
- Almost all Bulgarian orthopaedic surgeons and residents considered that the specific fields (bone biomechanics, vascularization, fracture classification, fracture fixation, reparation systems, complications etc) would be interesting regarding ***hand fractures and implants to fix hand fractures***.

- The majority of Bulgarian orthopaedic surgeons and residents considered that the specific fields (bone biomechanics, vascularization, fracture classification, fracture fixation, reparation systems, complications etc) would be interesting regarding ***backbone fractures and implants to fix backbone fractures***.
- Four Bulgarian orthopaedic surgeons/residents noted that the specific fields (bone biomechanics, vascularization, fracture classification, fracture fixation, reparation systems, complications etc) would be interesting regarding ***long bone fractures***, two considered all kinds of fractures, one considered pelvic fractures, and one considered lower extremity fractures.
- The ***expectations*** of the Bulgarian orthopaedic surgeons and residents were to increase their knowledge and their professional skills and share experience with other professionals. The practical & interesting contents, the easiness & usability in the course access, need of few time to carry the course out, and the useful contents for the job were considered important ***requirements*** to take a course from most Bulgarian orthopaedic surgeons/residents. The ***amount of time*** necessary to complete successfully the course is 40 - 80 hours and the ***amount of money*** that Bulgarian surgeons would be willing to pay was less than 300 euros, even less than 100 euros.

RECOMMENDATIONS

The novelty of the osteosynthesis for Orthopaedic surgeons component of the OrthoBioMed project lies with its procedure-specificity. It will be usefull to apply the fixation methods in specific anatomic regions, including the hand.

SUMMARY

Osteosynthesis (fracture fixation) is one of the two major components of the surgical treatment of fractures that includes closed or open reduction and fixation. By addressing the training requirements of the orthopaedic surgeons both the surgeons and the patients will benefit from the increase of knowledge and professional skills of orthopaedic surgeons.

Need analysis report for Biomedical Engineering done at the Technical University of Sofia

Background

This project is aimed at adapting and integrating innovative training courses and results from previous Leonardo da Vinci project into continuing VET of medicine professionals (residents, surgeons) and professionals involved in implants development and manufacturing. Its aim is to meet the training requirements of biomedical engineers, orthopaedic surgeons, managers, residents in the sector which have arisen due to developments in biomedical engineering and information and communications technology in order to select and analyse the e-learning innovative content from Osteoform project to meet these needs and upgrade the content with the new developments in the sector. The final objective is to adapt, upgrade and implement the Osteoform e-learning materials to the legal framework, training system, and language in Bulgaria and Greece and to the needs of the target groups in all partner countries.

Purposes

- To identify and analyse user requirements and training needs on innovative eLearning materials and simulation software of the following target groups:
    - medicine engineers and students needing knowledge and skills in biomechanical engineering for working in the development and manufacture of osteosynthesis implants.
- To define the learning outcomes and the corresponding training course modules.

Limitations

The well-known problem with questionnaires is the non-responsiveness. To overcome it, interviews have been used as well.

Questions

What knowledge and skills should provide one course in medical engineering?

What topics should cover the syllabus?

Do the students in medical electronics need courses on biomechanics?

Sample

The training needs of future engineers in medical electronics have been analysed of the students and teachers at the Technical University of Sofia:

- 4th year students in Bachelor degree which would continue in the Master degree where medical engineering is studied
- Master students who have courses in medical engineering
- Teachers in medical engineering.

Instrumentation

Questionnaires and interview.

Results

The questionnaires were published on the Web site of the Faculty of Electronic Technique and Technology, printed versions were distributed to the students during a lecture of the course Medical Image Processing. Only 5 on-line questionnaires were answered, and 21 paper-based.

Teachers in Medical engineering made non-structured interviews with some students (8-10). The questions of the interviews were same as in the questionnaire. The dean, the head of the department and four professors teaching courses in Medical engineering were interviewed as well.

Most of the answers were that a course in medical engineering should provide a grounding in fracture classification, fracture fixation (all), understanding of the concepts and principles of fracture classification, fracture fixation (19), and of the application and operation of medical imaging systems (20), practice design in bone biomechanics (16). The medical ethics relating to advances in medical technology was not so appreciated by the students (7).

The majority of respondents considered the online training modality as appropriate or really appropriate and declared that less than 100 hours of training would be necessary.

All students considered their level of knowledge in the specific fields (bone biomechanics, vascularization, fracture classification, fracture fixation, reparation systems, complications etc.) as intermediate and would like to increase their knowledge and skills in the respective fields.

The majority of respondents considered that the specific fields (bone biomechanics, vascularization, fracture classification, fracture fixation, reparation systems, complications etc.) would be interesting regarding backbone fractures and implants to fix backbone fractures.

With regard to the syllabus, all agreed about the need of a topic on anatomy. All topics in medical engineering (digital image processing, embedded system design, electromagnetic waves and the human body, advanced digital signal processing, acoustic environments and digital recording system, fibre optics, radio frequency engineering) were considered as important. The teachers commented that it was closer to their basic studies and this might be the reason for their selection. Imaging technology is liked by the students (20) although the teachers said that on the exam the performance was not so good. Regulations and standards

are less interesting for the students (4). In the comments they wrote that these regulations should be studied at the work place and are not so important for the university study.

Regular students in Bulgaria, most of which must work and learn, need alternative providing more flexible learning. They need a high-quality educational materials, and what is the most important, continually brought up-to-date courses. Without simulation effective Web-based instruction in medical engineering is impossible, so the learners are interested in both, the quality of the simulation facilities of the learning environment and the simulation-based tutorials and assignments.

Engineering students cannot assist at real surgeries, so they all considered that the virtual courses developed within the OrthoBioMed project will correspond to their needs.

The administrative staff (which are lecturers, too) interests are directed to the organizational impact of the teleteaching on the organization. They are interested in how the courses taught at distance will fit in the regular curriculum, how the telelearning will be organized with the available equipment, the students and tutors background, whether the presence of tutor will be necessary during the course.

Recommendations

The survey was made with regard to the education in Medical Engineering as a whole specialty in MSc in Electronics. Recommendations related to the analysis of needs for the training which is focused by the OrthoBioMed project were to regularly up-date the training materials because of the rapid development of both sciences – orthopaedic surgery and biomechanics.

Learning outcomes for the course on biomedical engineering

Knowledge: Basic knowledge in the mechanical behaviour of the bones. Advanced knowledge in design criteria for the musculoskeletal system.

Skills: Ability to apply optimisation criteria in the design of the musculoskeletal system in order to achieve minimisation of the level of stress to which its components are subjected under physiological loads while maintaining the mechanical support and protection functions with minimum weight.

Competences: Demonstrate innovation, autonomy, scholarly and professional integrity and sustained commitment to the development of new modelling and design rules at the forefront of work or study contexts including research in osteosynthesis design.

Summary

This report presented the analysis of specific requirements of students in medical engineering with regard to the content and techniques for delivery of training materials in the OrthoBioMed system in Bulgaria. The students in medical engineering and their teachers are a target group in this project together with the medicine doctors. They need courses providing knowledge about the subject of the devices they are developing. They cannot assist at real surgeries, so the virtual courses developed within the OrthoBioMed project will correspond to their needs.

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NEED ANALYSIS REPORT DONE BY THE DEPARTMENT OF ORTHOPAEDIC SURGERY & MUSCULOSKELETAL TRAUMA (DOS), UNIVERSITY OF THESSALIA

EXECUTIVE

This need analysis provides the analysis findings of a questionnaire answered from Greek Orthopaedic Surgeons of different training and experience levels, on the topic of the Surgical Management of Fractures through fixation (Osteosynthesis) and the existing knowledge and potential training the Orthopaedic Surgeons need, in the frame of the OrthoBioMed project.

INTRODUCTION

This report includes the following sections: background, specific purposes, limitations, questions, methods, samples, instrumentation, results, and recommendations.

The need analysis was conducted from the Department of Orthopaedic Surgery & Musculoskeletal Trauma of the University of Thessalia, in Larissa Greece and the questionnaire was answered from Greek Orthopaedic Surgeons of different training and experience levels.

BACKGROUND

The present need analysis was done within the Lifelong Learning Program (LLP) – Leonardo da Vinci – which is entitled "Osteosynthesis for Surgical Management of Fractures for Orthopedic Surgeons and Biomedical Engineers". The osteosynthesis is the surgical fixation of fractures after reduction with closed or open methods and is performed by every practising orthopaedic surgeon. Its overall of the OrhoBioMed project lies within the scope of the LLP initiative goals as set by the European Community in an effort to support education and training, and enhance the development of skills across Europe. In specific, the aims of the project are:

- To identify and analyse the needs of biomedical labour market, of biomedical engineers, orthopaedic surgeons, managers, residents in the sector.
- To select and analyse the e-learning innovative content to meet these needs and upgrade the content with the new developments in the sector.
- To adapt, upgrade and implement the Osteoform e-learning materials to the legal framework, training system, and language in Bulgaria and Greece and to the needs of the target groups in all partner countries.

The aims of the project will be accomplished by developing and carrying-out a combination of activities, starting from the identification of the specific needs of the users in the health-care sector. This is a very important and necessary first step of the

whole project towards the realization of the next steps, with emphasis on proper material selection and adaptation of new courses in a technically innovative performance support environment that can meet the real training needs of the medical staff.

Specific Purposes

The need analysis within the project activities intends to identify and analyze precise user requirements and real training needs of staff in the medical/paramedical sector on the field of fracture fixation (osteosynthesis). The goal of the analysis was first to confirm and clarify the existence of specific needs on innovative e-learning materials, special topics of interest, and problem-based learning skills in osteosynthesis. Next, the results of this task were "translated" and analyzed in a way so as to support the decision-making procedure for providing the best training framework and most appropriate modules to be adopted in the support environment. Consequently, the results will allow the development, adaptation and upgrade of any traditional and out-of-date material, tool, practice and platform to a more targeted, technically sophisticated and integrated e-learning process.

Limitations

Beyond inherent limitations of each tool used in the need analysis, professional, local medico-legal and social differences may have been underestimated. Although the sample was quite representative all the people that have been selected to take part in the survey were orthopaedic surgeons (professors, consultants and residents). The limited number of respondents does not permit a formal analysis of professional and social diversity.

Questions

The addressed questions were clear with multiple possible answers, and were set with different wording so as to gather more useful answers.

Methods, Samples & Instrumentation

The ***methods*** and ***instrumentation*** used in this analysis were primarily surveys and interviews aiming at incorporating the opinions of different groups of professionals in the medical sector, after a careful review of the literature in the field of fracture fixation. The main approach used was interviews, during which a specific form of a 34-item, web-based questionnaire (same with the one given by the rest of the partners in the project) was used from the Greek Orthopaedic Surgeons. The questionnaire focused on the knowledge already acquired in the fields of bone biology and biomechanics, fractures, and osteosynthesis and on the necessity of training in the

respective fields. In particular, the respondents were medical doctors and residents, with the majority being surgeons in orthopaedics. Surveys and interviews were conducted at the Department of Orthopaedic Surgery and Musculoskeletal Trauma of the Faculty of Medicine of University of Thessalia and took place in January 2014 in Larissa, Greece.

The ***sample*** was quite representative (18 people in total filled the questionnaire) and differed as of the specific major/discipline/area of the medical practice (even in the orthopaedics section), as well as seniority, age and gender. However, all the people that have been selected to take part in the survey were orthopaedic surgeons (professors, consultants and residents). Those people were also selected after a careful analysis of the specific groups of potential actors that will benefit the most from the existence of the vocational learning environment that is to be developed. Interviews with the following groups of surgeons were conducted:

- Orthopaedic surgeons (consultants and faculty members): 7 of 18 participants, the vast majority of them having more than 16 years of experience in orthopaedic surgery
- Residents in orthopaedics: 11 of 18 participants

RESULTS

The results of the specific need analysis carried out in Greece provided the following observations:

- The majority of Greek orthopaedic surgeons and residents (14/18) find their ***training*** appropriate (12) or really appropriate (2) and 72.2% of them have received training in their specific field in the last 2 years from national societies of orthopaedic surgery, arthroscopic societies, universities and from the AO foundation.
- The majority of Greek orthopaedic surgeons and residents (14/18-78%) considered the ***online training modality*** as appropriate (13) or really appropriate (1) and declared that less than 100 hours of training would be necessary.
- The majority of Greek orthopaedic surgeons and residents considered their ***level of knowledge*** in the specific fields (bone biomechanics, vascularization, fracture classification, fracture fixation, reparation systems, complications etc) as intermediate and would like to increase their formation in the respective fields.
- Almost all Greek orthopaedic surgeons and residents considered that the specific fields (bone biomechanics, vascularization, fracture classification, fracture fixation, reparation systems, complications etc) would be interesting regarding ***hand fractures*** (83%)***and implants to fix hand fractures*** (89%).
- Fifty per-cent of Greek orthopaedic surgeons and residents considered that the specific fields (bone biomechanics, vascularization, fracture classification, fracture fixation, reparation systems, complications etc) would be interesting regarding ***backbone fractures and implants to fix backbone fractures***.

- Four Greek orthopaedic surgeons/residents noted that the specific fields (bone biomechanics, vascularization, fracture classification, fracture fixation, reparation systems, complications etc) would be interesting regarding ***lower limb fractures***.
- The ***expectations*** of the Greek orthopaedic surgeons and residents were to increase their knowledge and their professional skills. The practical & interesting contents, the useful contents for the job and the qualified and expert teachers in the field were considered important ***requirements*** to take a course from most Greek orthopaedic surgeons/residents. The ***amount of time*** necessary to complete successfully the course is less than 40-80 hours and the ***amount of money*** that Greek surgeons would be willing to pay was less than 300 euros (50% are willing to pay was less than 100 euros).

RECOMMENDATIONS

The novelty of the osteosynthesis for Orthopaedic surgeons component of the OrthoBioMed project lies with its procedure-specificity. It will be usefull to apply the fixation methods in specific anatomic regions, including the hand.

SUMMARY

Osteosynthesis (fracture fixation) is one of the two major components of the surgical treatment of fractures that includes closed or open reduction and fixation. By addressing the training requirements of the orthopaedic surgeons both the surgeons and the patients will benefit from the increase of knowledge and professional skills of orthopaedic surgeons.

Conclusions on the necessary courses/training modules for re-training the professionals in the sector

Introduction

The main objective of this report is to set the characteristics of the training course that will be adapted from the Osteoform Project.

The report will constitute the point of departure for the integration and adaptation of the teaching contents that will be carried out during the third work package of the project.

Duration

The duration of the course will be 60 hours, divided in two parts:

THEORETICAL LESSONS	**30 hours**
PRACTICAL LESSONS	**30 hours**
FULL DURATION	**60 hours**

This duration has been established with the aim of creating an attractive course that could give to the users a specific preparation on relevant aspects of their work and a useful tool to enhance their knowledge level.

Contents

Concerning the interests of each professional profile, the learning necessities questionnaires involved different learning areas.

All the proposed contents were considered as interesting (no one got a percentage lower than 60%), and all were evaluated as important for the work performance.

The main contents requested by **the medical profile** were the following: all the contents about *bone biomechanics* area, and also clinical aspects such as *osteosynthesis mistakes, results monitoring* and *vascularisation conservation.*

The main contents requested by **the technical profile** were the contents about reparation products: *Orthopaedic fracture reparation systems, bones remodelling. Mechanical adaptation, fracture's anatomic reduction, surgical fracture reparation systems, fractures stabilization*, and biomechanics: *biomechanical study of the fracture, bone biomechanics*.

Moreover, both groups found interesting the contents about *controversies and new trends*.

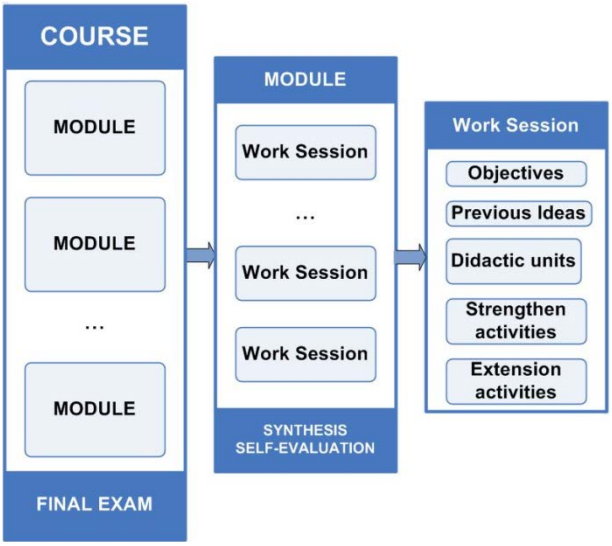
Other learning areas suggested by the participants, and not initially included into the proposed contents, were *instrumentation and post traumatic rehabilitation*.

Based on this information, the contents that will be included into the course will be:

- **Functional biomechanics of the bones:** *bone biomechanics, biomechanical study of the fracture.*
- **Treatments:** *Orthopaedic fracture reparation systems, bones remodelling. Mechanical adaptation, fracture's anatomic reduction, surgical fracture reparation systems, fractures stabilization.*
- **Clinical aspects:** *osteosynthesis mistakes, results monitoring* and *vascularisation conservation.*

The survey emphasized some differences between the medical and the technical profiles. In fact, some learning areas result very interesting for the surgeons and are less relevant for the engineers, and vice versa.

The course will be organized following the scheme presented below:



So, in order to optimize the learning process, the course for clinicians and the course for technicians will have the same modules, but there will be differences regarding the work sessions and the didactic units. The subdivision will be detailed during the exploitation WP 6 , when the learning contents will be selected for each group of trainees.

Learning Outcomes for the Training Courses

Course	Knowledge	Skills	Competences
Biomechanical analysis of bone in terms of its structure	Advanced knowledge in structural behaviour of the bone.	Ability to determine the stress-strain state in the bone	Manage the definition of complex design criteria applied to the femur.
Factors influencing fracture repair and assessment methods	Advanced knowledge of fracture consolidation mechanisms and main factors influencing fracture repair, according to the different dependent variables.	Ability to promote the mechanisms of fracture healing. Ability to use the non-invasive assessment methods and the therapeutic factors.	Manage the use of non-invasive assessment methods in fracture diagnosis and repair.
Skeletal adaptation to functional stimuli	Advanced knowledge of concepts related to bone remodelling and adaptation.	Ability to use the different variables that influence the mechanical adaptation process of bone tissue.	Demonstrate autonomy, professional integrity and commitment to the use of designed rules for bone adaptation.
Orthopaedic fracture repair systems	Advanced knowledge of fracture repair methods and characteristics of different (conventional/functional) plaster casts.	Ability to apply the suitable osteosynthesis method for a certain type of fracture.	Demonstrate autonomy in the application of each method of surgical fracture repair: conventional and functional plaster casts.

Surgical fracture repair systems	Advanced knowledge of the main functions of different surgical fracture repair methods (osteosynthesis) including screw fixation, plates, IM nails and external fixators.	Ability to select the suitable osteosynthesis method for a certain type of fracture.	Demonstrate autonomy, professional integrity and commitment to the application of each method of surgical fracture repair (screw fixation, plates, IM nails and external fixators) according to the basic principles related to the function of different fixation systems.
Principles of Surgical Treatment of Fractures	Advanced knowledge of anatomic reduction, stability of osteosynthesis and preservation of blood supply.	Ability to select the correct indications according to the fracture characterists and apply the principles of osteosynthesis so as preserve the blood supply, obtain anatomic reduction and stable osteosynthesis.	Manage complex technical and surgical activities, taking responsibility for decision-making in predicted and in-predicted situations in Surgical Treatment of Fractures.
Errors in Osteosynthesis	Knowledge on the fundamental differences of *errors* and *complications* and ways to avoid repeating known errors. Knowledge of the biologic input of fracture healing (bone grafting).	Ability to make the correct preoperative planning and implant choice as well as discriminating in what cases is bone graft addition is necessary.	Demonstrate autonomy and pro-fessional integrity and avoid errors when performing an osteosynthesis, by the use of pre-operative planning and correct implant choice, while being aware of the importance of self-criticism and self-audit.

New Tendencies in Orthopaedic Surgery and Traumatology	Highly specialised knowledge on new concepts of osteosynthesis, tissue regeneration therapies, and good practices, documentation and continuous evaluation of results in orthopaedic surgery and traumatology.	Ability to use the most frequent standardisation systems and Clinical Practice Guidelines. Ability to apply the concept of Evidence-Based Medicine and to use Information and Communications Technology (ICT) in documentation and evaluation of results. Ability to make the correct choice of tissue regeneration therapies.	Correct management of documentation of clinical cases and continuous evaluation of the osteosynthesis results. Manage the application of new concepts in osteosynthesis. Manage the application of Platelet-Rich Plasma and mesenchymal stem cells in the therapy of the musculoskeletal system pathology.