Preface

The annual report from the Danish Fracture Database (DFDB) 2015 is the third of its kind. It contains data based on over 40.000 fracture related surgeries, of which over 30.000 are primary surgeries registered at www.dfdb.dk. The purpose of DFDB is web based quality monitoring of fracture related surgery and today these efforts are joined by 20 orthopaedic departments in Denmark, covering close to 90% of the Danish population. The effort to monitor quality of fracture related surgery in Denmark is unique and important: Unique because DFDB is the fracture register with the highest national coverage in the world and important given the high number of surgeries performed each year probably making fracture surgery/traumatology one of the busiest specialties within orthopaedic surgery. Previously it has not been possible to assess nationwide quality of all fracture related surgeries.

We wish to thank all the participating surgeons and departments taking part in this unique and important task. It is truly inspirational to realize the unity DFDB has brought into orthopaedic traumatology in Denmark. Also the continued support from The Danish Orthopaedic Society (DOS) and Danish Orthopaedic Trauma Society (DOT), and the possibility to present the annual report at the DOS Congress is much appreciated.

The annual report is structured as previously with general data overview of registered parameters followed by department specific data, and finally the major body of the report with specific data for each anatomic region, e.g. proximal humerus, distal radius, and proximal femur. This years focus area is surgically treated clavicular fractures, a hot topic in recent years, and currently under scrutiny with new national treatment guidelines being recently published by DOT.

A basic principle surrounding DFDB is that surgeons reporting to the database should get feedback concerning the quality of treatment. This is delivered via e-mail and entails surgeon specific (only to be seen by the individual surgeon), department specific (the surgeon can only see data from his/her own department), and nationwide feedback on the rate of reoperations performed. The level of detail send by e-mail can be configured by the surgeon when logged in to DFDB. It is our hope that with time this feedback from DFDB can support surgeons in making decisions about best practice in fracture related surgery.

In Sweden a Fracture Register has been established too (www.frakturregistret.se). DFDB has engaged in cooperation with colleagues in Sweden and Norway to establish a core dataset of common parameters that will make it possible to join data and efforts across Scandinavia. Further, the efforts to become a national clinical quality monitoring database are ongoing. Finally, a platform to scan, trace and monitor orthopaedic implants has been introduced and taken in use at one department. The scanned implants are linked together with registrations in DFDB. It is a hope that the needed and important task of monitoring quality of specific implants and groups of implants can soon be undertaken in DFDB.

We hope to see more departments join DFDB in the future.

Hvidovre, d. 12. September, 2015

Anders Troelsen, Michael Brix, Kirill Gromov

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About the Danish Fracture Database

Background and recent development

The aim of the Danish Fracture Database is to monitor the quality of surgical fracture treatment by assessing the rate of revision surgery both in general and for each fracture type specifically. This assessment results in a potential quality improvement through focus on specific fracture types where the quality of treatment is not considered high enough. Lastly, epidemiologic research in fracture surgery will contribute to identify surgical and fracture related prognostic factors for a good or poor outcome of surgery. The use of DFDB provides each participating department the possibility to monitor own data and thus the quality of their fracture treatment. The educational level of both the surgeon and the supervisor is registered and can therefore also be monitored. During the past year, there has been a marked escalation of data entry. The number of registered surgeries has increased from approximately 28.000 in 2014 to more than 40.000 in 2015.

Steering Committee

The idea behind DFDB and the registry's recent progress are attributed to Michael Brix and Anders Troelsen. Kirill Gromov contributed substantially to the registry's developmental phase. Michael, Anders and Kirill are today a part of the DFDB steering committee and are responsible for the registry's overall administration, quality monitoring, and research. In addition, each participating department is represented in the steering committee. Both DOT (Danish Orthopaedic Trauma Society) and DOS (Danish Orthopaedic Society) are represented in the steering committee. A minimum of one annual meeting is held in order to correct inexpediencies, increase the usability, and optimize the database through the members' feedback.

Secretariat and daily operations

Each participating department has a controller in daily charge of complete reporting. The daily operation is also supported by a secretariat, which was established last year at the Department of Orthopaedic Surgery, Hvidovre Hospital. The secretariat consists of an administrator, Alina Hansen, and a statistician, Thomas Kallemose.

Together the developers of DFDB and the secretariat has the responsibility and right to development and changes of the registry in cooperation with the provider Procordo Aps.

Summary and comments

In this annual report from DFDB we present a general overview of registered data as well as data for specific anatomical regions. The general overview covers basic demographics (age, gender and ASA score) for all primary surgeries as well as reoperations. Anatomical distribution of registered primary surgeries and reoperations as well as indications for reoperations are described. We describe the educational level of the primary surgeon and level of supervision for primary surgeries. Anatomical distribution for primary surgeries for all separate departments participating in the DFDB collaboration is described in the first part of the report.

For definitions and specifications of the different parameters please see Appendix 1.

Demographics

84% of primary procedures were due to adult fractures and 16% due to pediatric fractures.

Age distribution was biphasic, with first peak at age 0-20 and second peak at age 60-90. More males were surgically treated for fractures when age <50, while more female were surgically treated for fractures when age >50. 76% of patients with primary surgeries had ASA score 1-2 while 78% of patients with reoperations had ASA score 1-2. 56% of all registered patients were female.

Anatomical distribution

Proximal femur (35%), distal radius (15%), and malleoli (12%) were the 3 most frequent operated regions for primary adult surgical procedures. Radius/ulna (58%), humerus (22%), and tibia (9%) were the 3 most frequently operated regions for primary paediatric surgical procedures.

Reoperations

Proximal femur (27%), malleoli (20%), and distal radius (7%) were the 3 most frequently reoperated anatomical regions in adults. Radius/ulna (47%), humerus (21%) and tibia (18%) were the 3 most frequently reoperated anatomical regions in children. Pain and discomfort due to osteosynthesis material (38%), secondary fracture dislocation (15%), and infection 13%) were the 3 most frequent indications for adult reoperations. Secondary fracture dislocation (39%), suboptimal osteosynthesis (21%), and pain and discomfort due to osteosynthesis material (22%) were the 3 most frequent indications for paediatric reoperations.

Level of education

60% of all primary surgeries were performed by surgeons in training (intern- 5th year resident). Interns, 1st year resident, 2nd year resident, and 3rd year residents performed more procedures under supervision than without supervision, while 4-5th year residents, attending surgeons, and traumatologist performed more procedures without supervision than with supervision

Data limitations

There are some limitations to the data in this report. Essential limitations are:

1) Data completeness for treatment of primary fractures

2) Data completeness for reoperations

Initially, after full implementation of DFDB at the orthopaedic departments in Hvidovre and Odense, an evaluation of data validity and data completeness for treatment of primary fractures and reoperations was performed (Gromov 2013). Two plausible factors to limit data completeness were identified: 1) that the registry had only been implemented for few months, and 2) that both departments are large, with regularly 50-90 possible surgeons. The results of the study showed that the validity of data (the percentage of data that was correct when compared to the best external data source outside of DFDB) was 90-100% for all parameters, and most above 97%. The total degree of completeness for data entry of primary fracture treatment was 88% and for reoperations it was 77%. Thus, there was, at an early point in time after initiation of DFDB, a satisfactory degree of data validity and data completeness under the prevailing circumstances. Similar evaluations of data completeness should be performed continuously.

Another limitation is lacking reoperation data performed at non-participating departments where the primary operation was performed and registered at a participating department. The extent of this phenomenon can be investigated by using data from the National Patient Registry (Landspatientregistret, LPR). For this year's report, data was not extracted from LPR with regards to knowing the "true" number of reoperations, why the rates of reoperations and survival curves are underestimated. However, as the number of departements participating in DFDB collaboration has risen to 20, covering close to 90% of the Danish population, such underestimation is significantly reduced. Reoperation rates and curves are presented to illustrate the potential of data analysis with the DFDB.

Currently, work is ongoing to validate the primary fracture codes that are registered in the LPR, to know the validity of these codes if they are to be used as a data source for the DFDB. Furthermore, definition and validation of the reoperation codes in LPR to investigate the applicability of the LPR as a data source for the DFDB is ongoing.

Fracture diagnosis in Danish National Patient Registry (NPR) have been investigated by Andersen et al. The overall validity of data was 86%. The NPR diagnosis code was correct in 94% of all cases and the NPR anatomic region was correct in 99% of all cases. In 91% of all cases the operation code was correct and the anatomic region for the operation was correct in 99% of all cases. NPR coding will be used in the future for continuous completeness monitoring of DFDB data.

Data was extracted from DFDB on August 8th 2015.

References

Gromov K, Fristed JV, Brix M, Troelsen A. Completeness and data validity for the Danish Fracture Database. Danish medical journal. 2013 Oct;60 (10):A4712. PubMed PMID: 24083526.

Participating departments

Aabenraa

Aalborg

Aarhus

Bispebjerg

Esbjerg

Farsø

Gentofte

Herlev

Hillerød

Holbæk

Horsens

Hvidovre

Kolding

Køge

Nykøbing Falster

Odense

Randers

Rigshospitalet

Slagelse

Vejle

Viborg

General overview of data

The graphs in this section covers general areas such as surgery type distribution, primary indication for re-operation, and primary surgeon, which uses data from all participating departments.

Fracture types
(41856)

Procedure types
(38262)
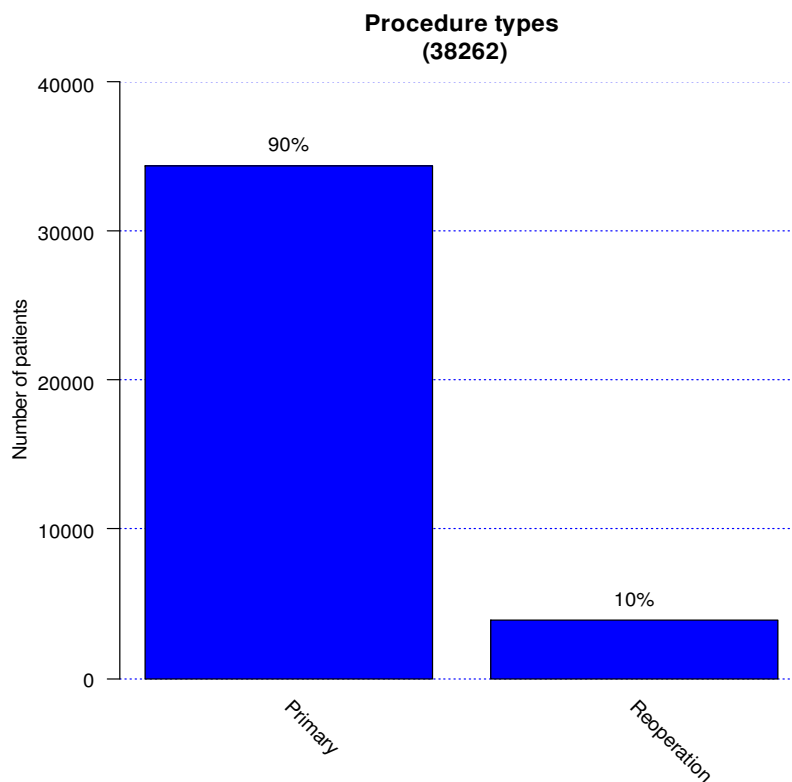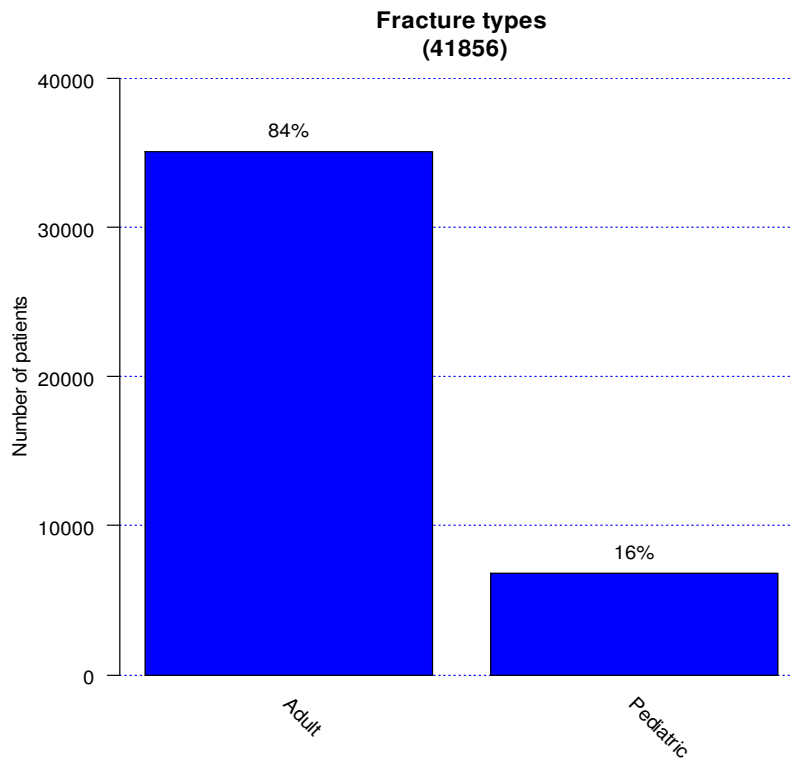
Procedure types by fracture types
(37815)
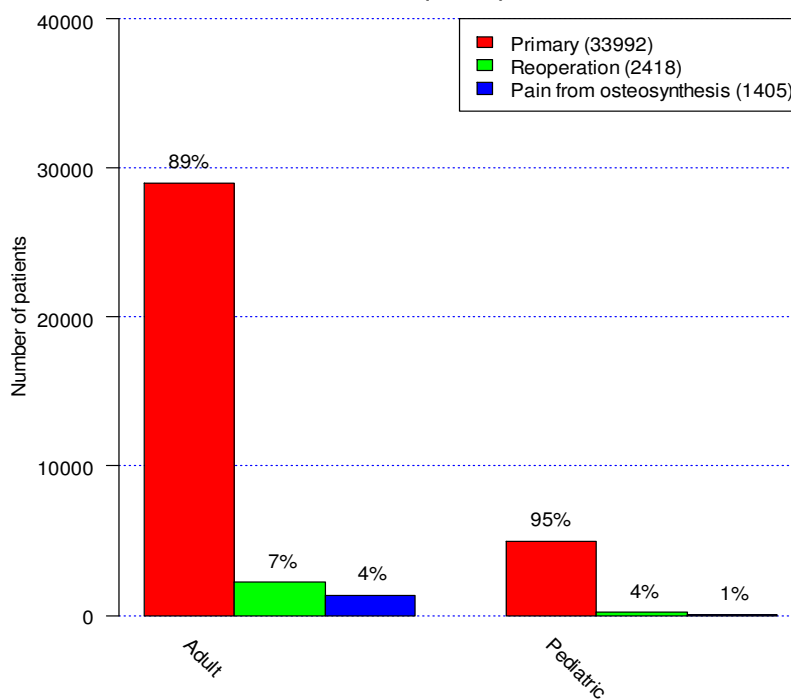
Anatomical distribution
Primary procedure
Adult fractures
(29018)
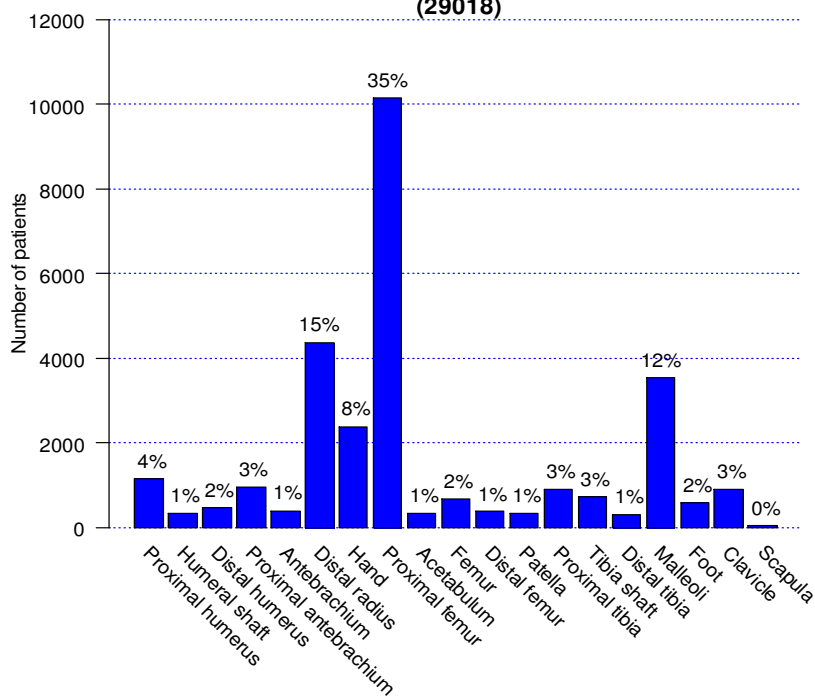
Anatomical distribution
Reoperations
Adult fractures
(3555)
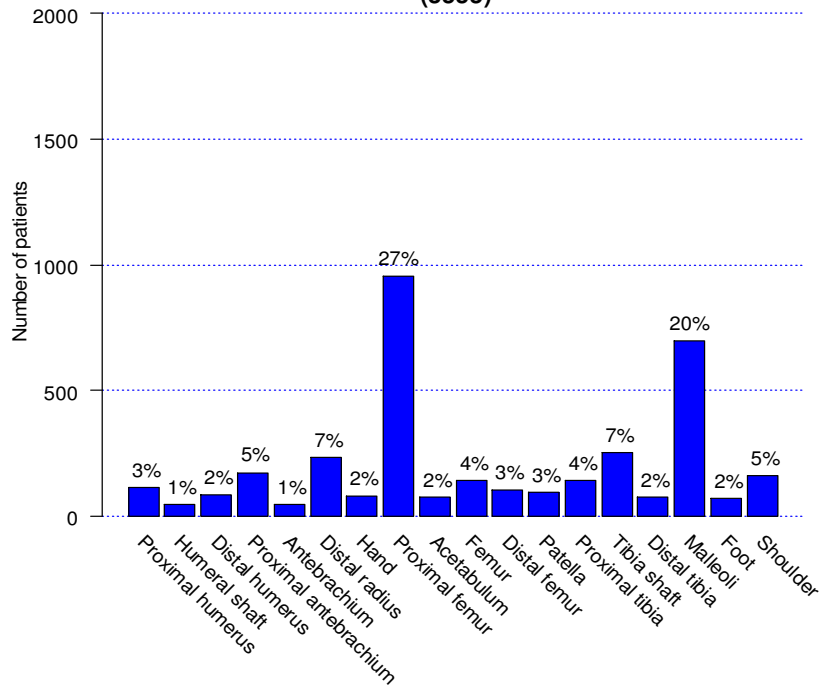
Anatomical distribution
Primary procedure
Pediatric fracture
(4985)
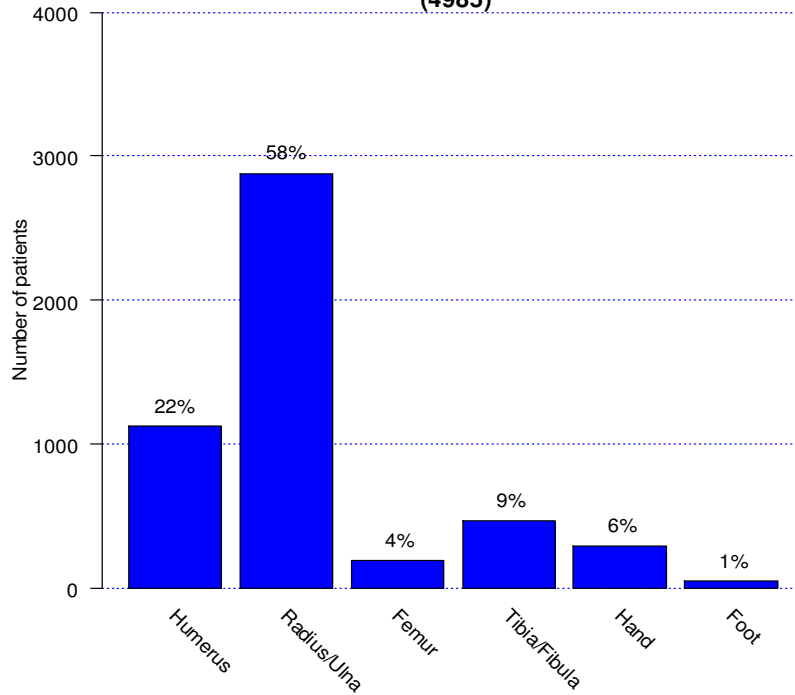
Anatomical distribution
Reoperation
Pediatric fractures
(267)
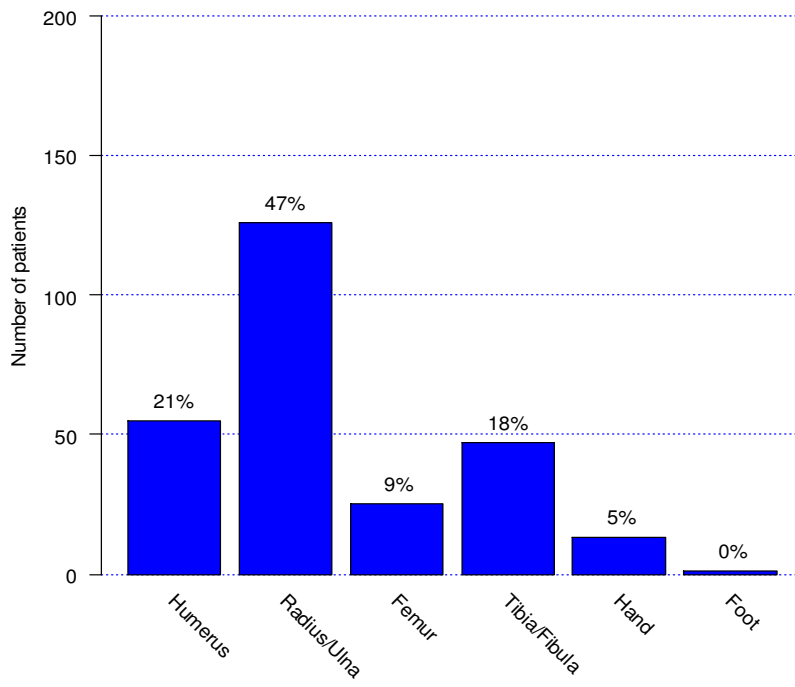
Primary indication for reoperation
Adult fractures
(3532)
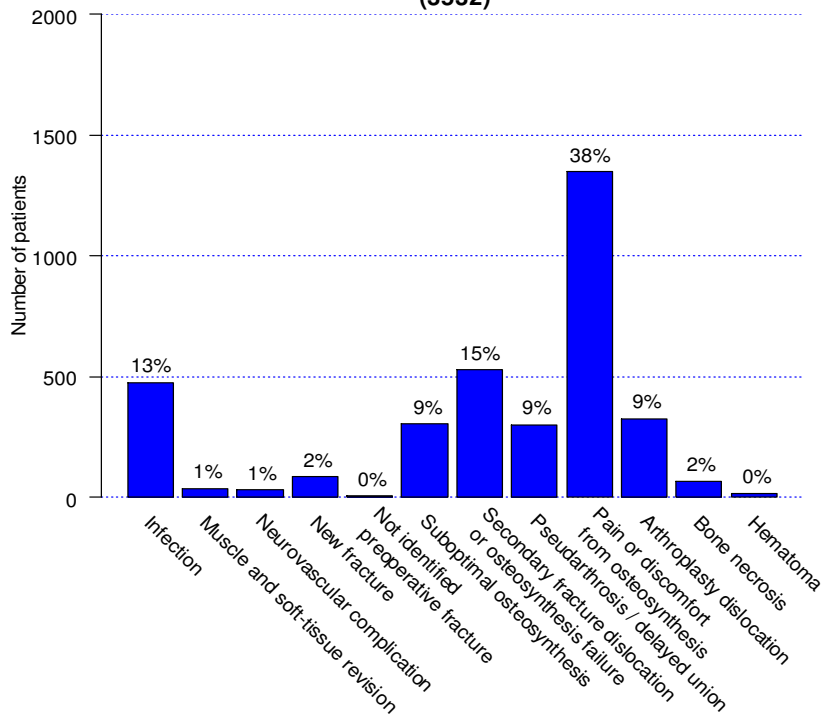
Primary indication for reoperation
Pediatric fractures
(263)

Number of patients

- Infection — 5%
- Muscle and soft-tissue revision — 1%
- Neurovascular complication — 1%
- New fracture — 5%
- Not identified — 1%
- Suboptimal preoperative fracture — 21%
- Secondary fracture dislocation or osteosynthesis — 39%
- Pseudarthrosis failure — 5%
- Pain or discomfort from osteosynthesis / delayed union — 22%
- Bone necrosis — 1%

ASA-score for procedure types
Adult fractures
(32563)

Number of patients

Legend:
- Primary (29007) — red
- Reoperation (3556) — blue

ASA score	Primary	Reoperation
1	36%	40%
2	40%	38%
3	23%	21%
4	2%	1%
5	0%	0%

ASA-score for procedure types
Pediatric fractures
(5250)

Gender
(42316)

Time of primary procedure
Adult fractures
(29007)

Time of primary procedure
Pediatric fracture
(4983)
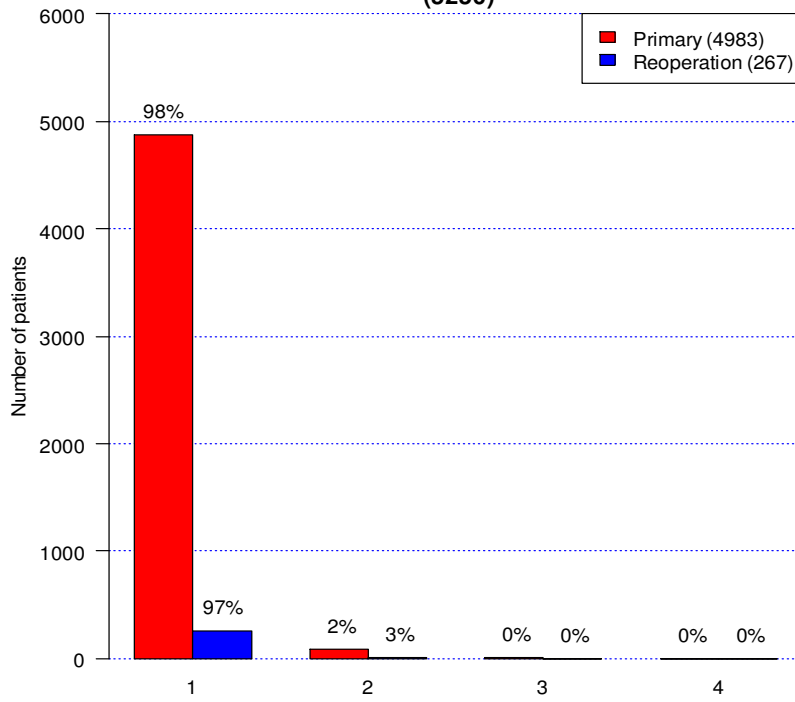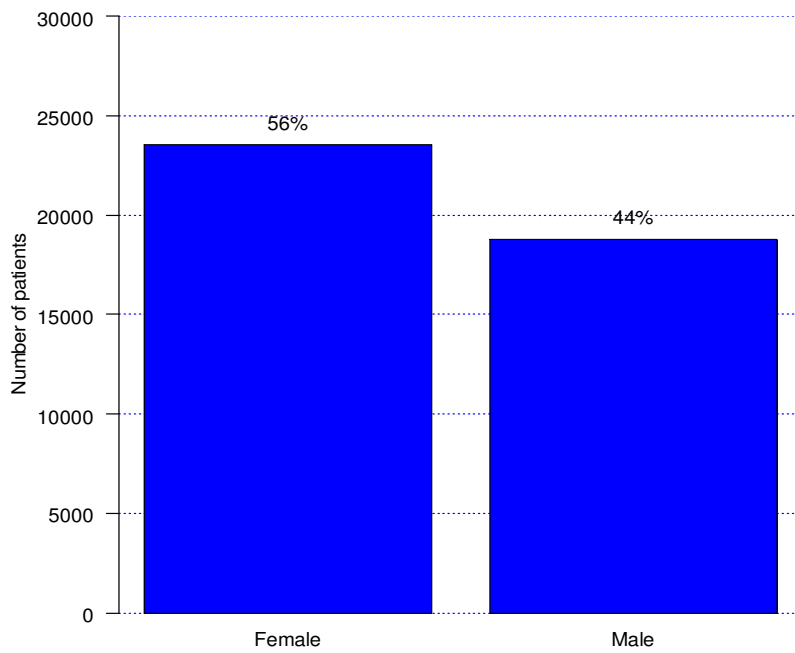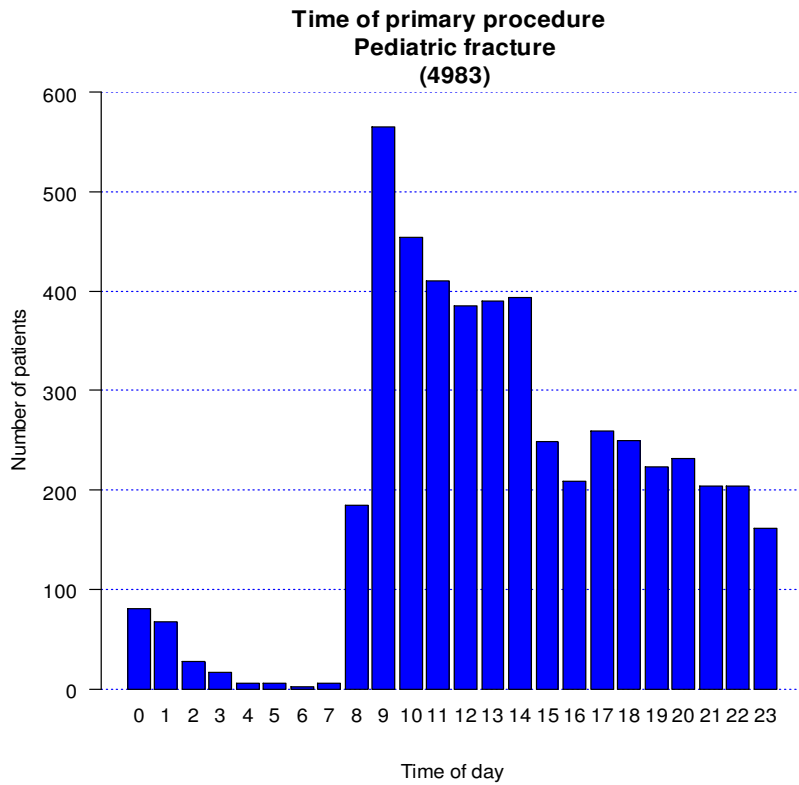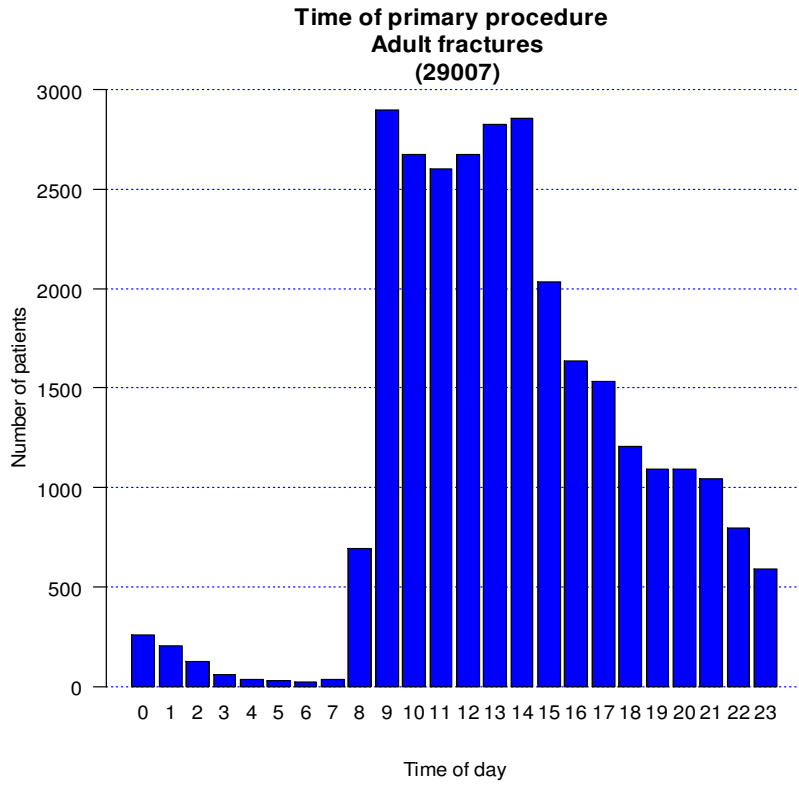
Surgeon level
Primary procedure
(34309)
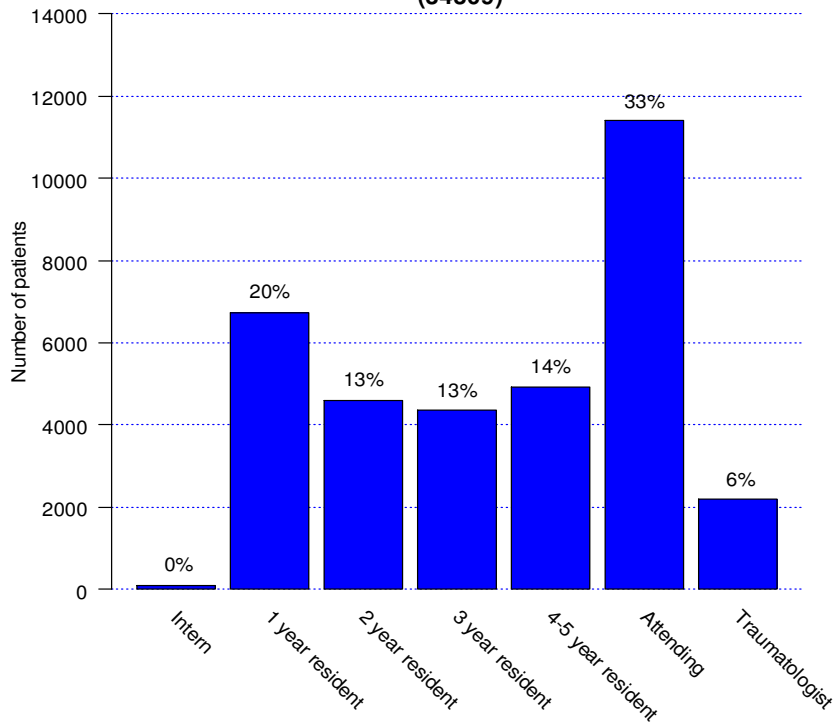
Surgeon level by procedure types
Adult fractures
(32520)

Legend: Primary (28965), Reoperation (3555)

Surgeon level by procedure types
Pediatric
(5246)

Legend:
- Primary (4979)
- Reoperation (267)
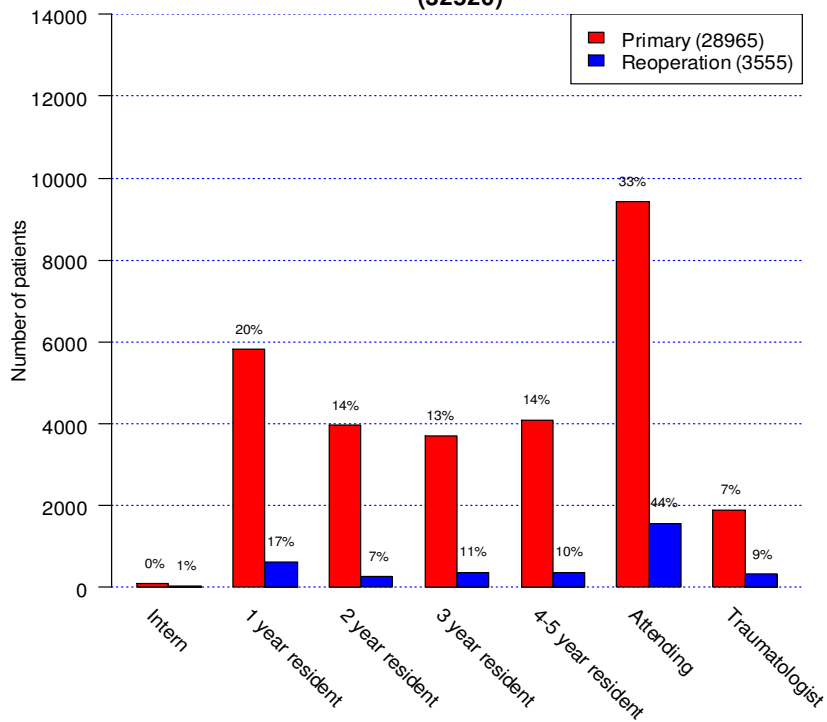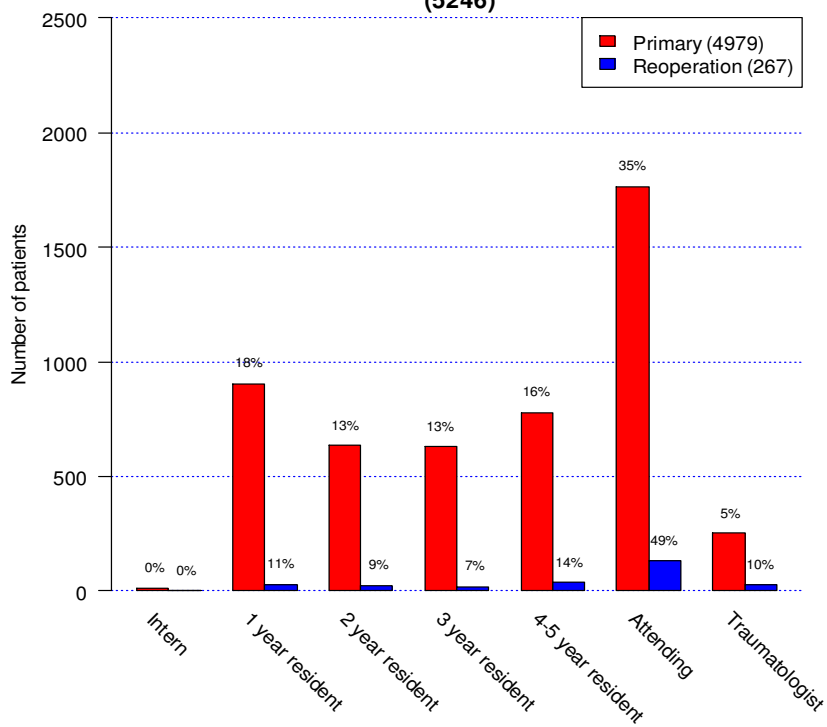
Time of primary procedure by surgeons level
Adult fractures
(28963)

Legend:
- Intern (88)
- 1 year resident (5813)
- 2 year resident (3962)
- 3 year resident (3695)
- 4-5 year resident (4090)
- Attending (9425)
- Traumatologist (1890)
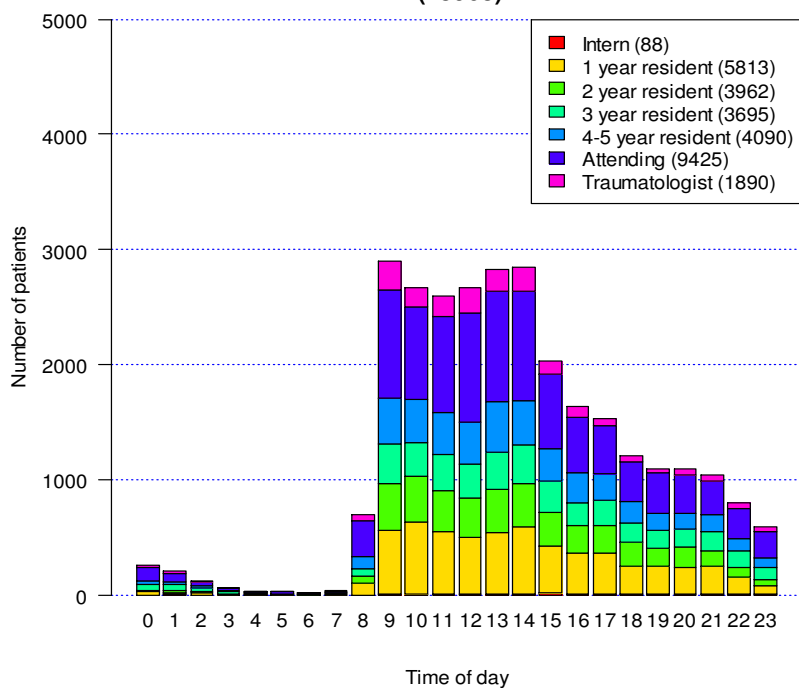
Time of primary surgery by surgeons level
Pediatric fractures
(4979)

Legend:
- Intern (15)
- 1 year resident (905)
- 2 year resident (635)
- 3 year resident (630)
- 4-5 year resident (778)
- Attending (1763)
- Traumatologist (253)

Y-axis: Number of patients
X-axis: Time of day
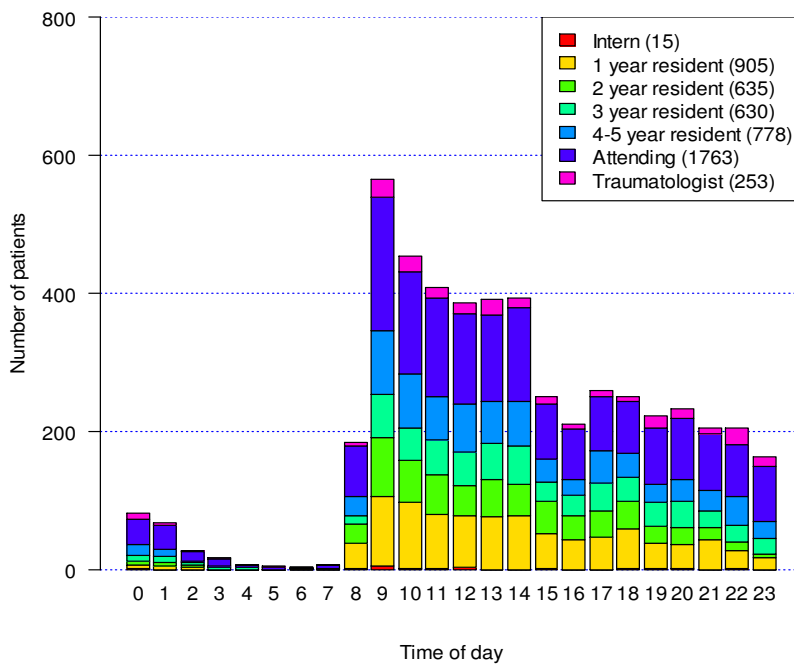
Level of supervision for all fracture types
Primary procedure
(33457)

Y-axis: Number of patients

Bar values:
- Intern: 0%
- 1 year resident: 0%
- 2 year resident: 1%
- 3 year resident: 2%
- 4-5 year resident: 8%
- Attending: 25%
- Traumatologist: 4%
- Unsupervised: 58%
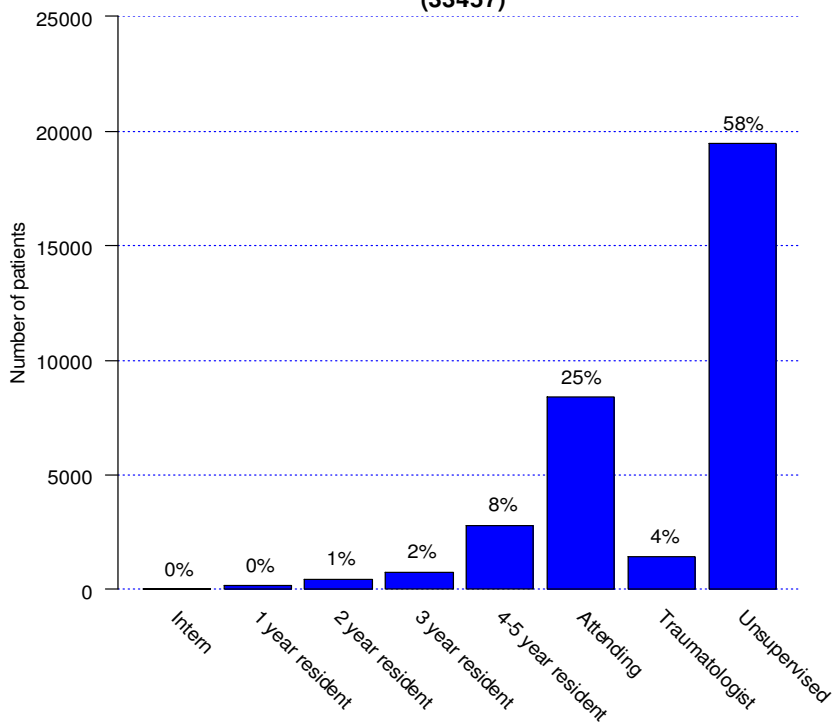
**Level of supervision for interns and residents
Adult fractures
(17559)**

Legend:
- Below attending (3566)
- Attending or above (7596)
- Unsupervised (6397)

Y-axis: Number of patients

Intern: 48%, 44%, 8%
1 year resident: 37%, 50%, 13%
2 year resident: 24%, 41%, 35%
3 year resident: 8%, 53%, 39%
4-5 year resident: 3%, 26%, 71%
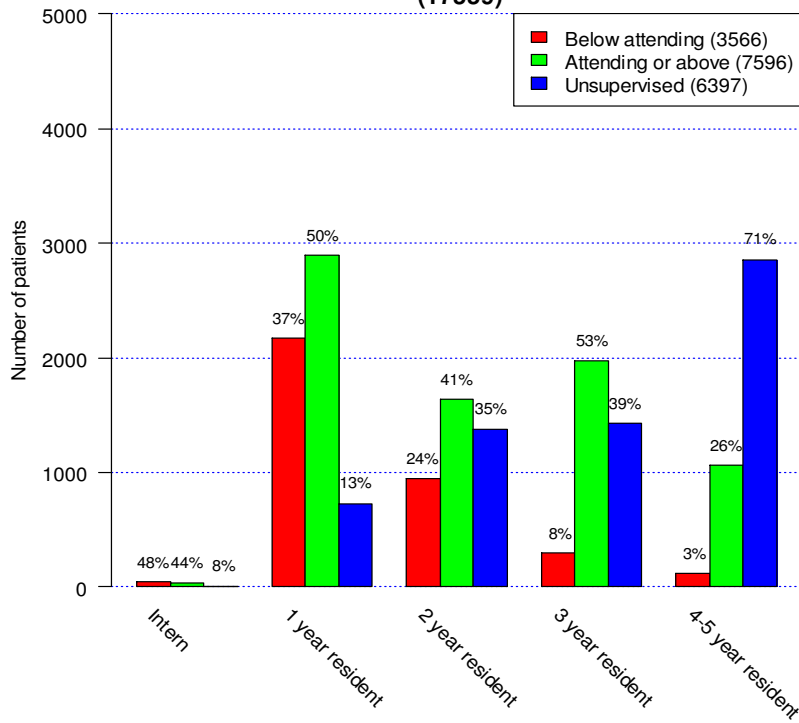
**Level of supervision for interns and residents
Pediatric fractures
(2943)**

Legend:
- Below attending (564)
- Attending or above (1183)
- Unsupervised (1196)

Y-axis: Number of patients

Intern: 36%, 64%, 0%
1 year resident: 37%, 50%, 13%
2 year resident: 24%, 38%, 38%
3 year resident: 11%, 49%, 40%
4-5 year resident: 1%, 22%, 77%
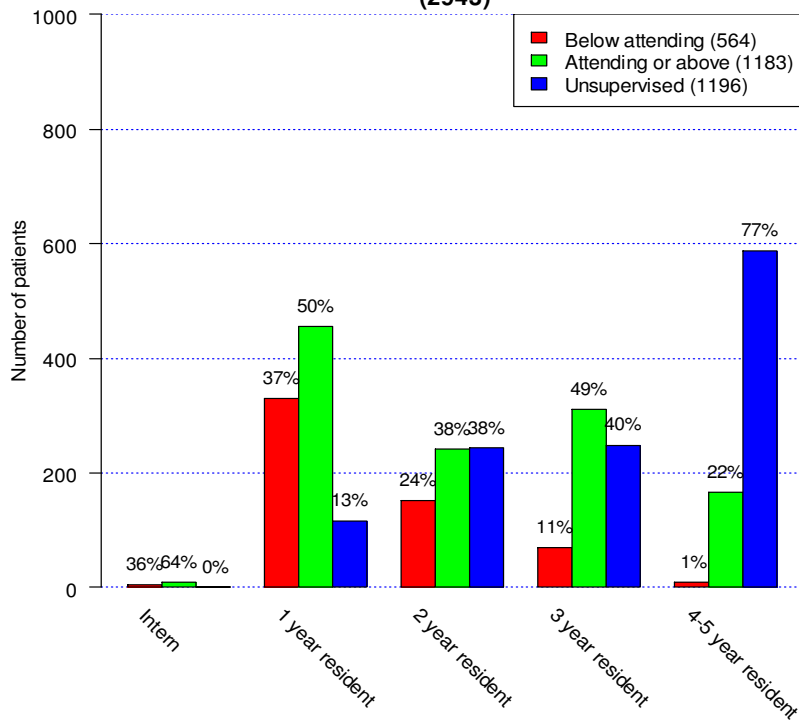
**Survival for primary procedure with reoperation
due to any reason as endpoint
All procedures
(34360)**
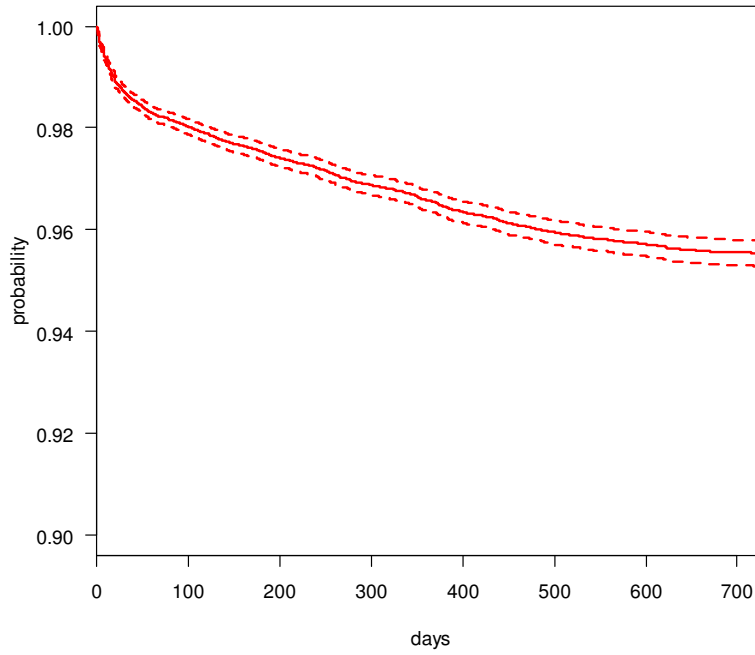
**Survival for primary procedure with reoperation due to any reason
except pain and discomfort from surgical hardware
All procedures
(34360)**
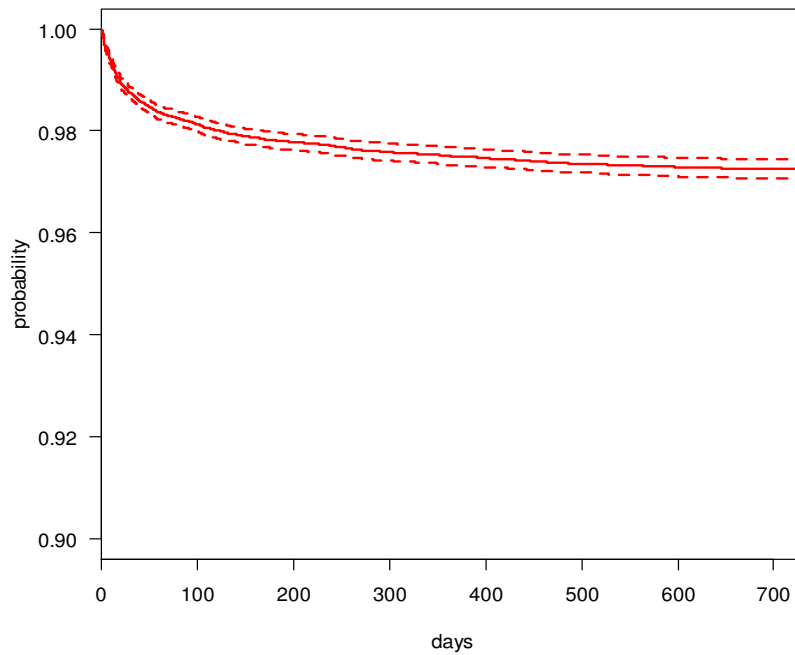
Survival for primary procedure with reoperation due to any reason
Adult and pediatric fractures
(33989)
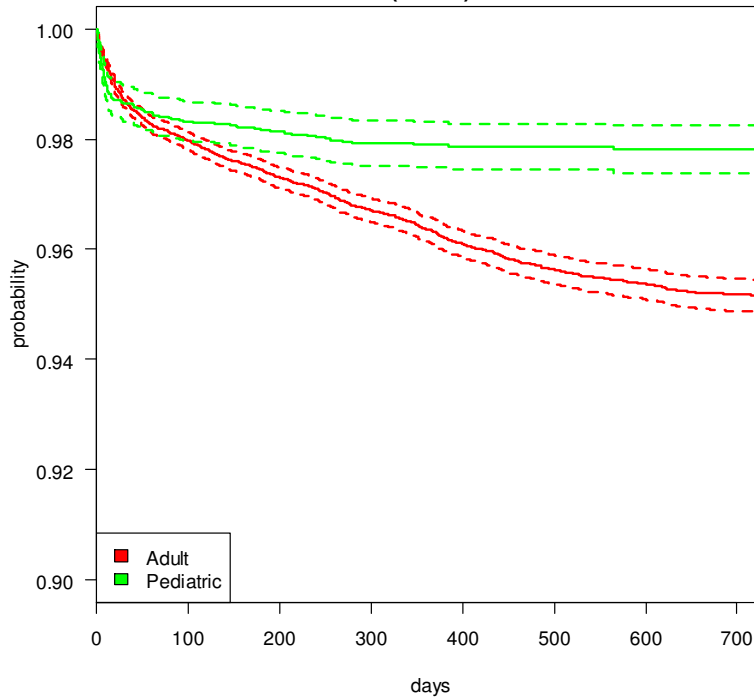
Age distribution for gender
Primary procedure
(34285)
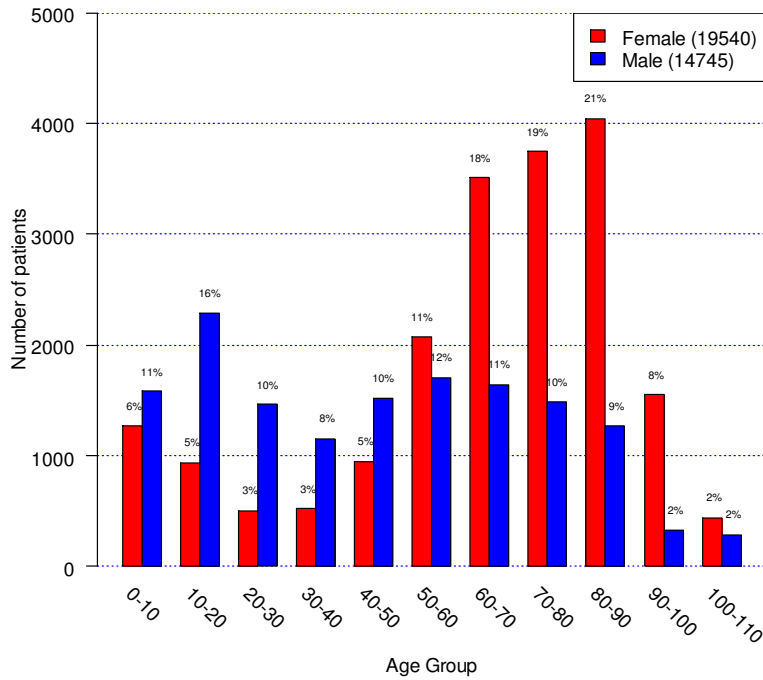
**Trauma patients by anatomical distribution
Adult fractures
(29012)**

Number of patients

Legend:
- No (27329)
- Yes (1683)

Categories: Proximal humerus, Humeral shaft, Distal humerus, Proximal antebrachium, Antebrachium, Distal radius, Hand, Proximal femur, Acetabulum, Femur, Distal femur, Patella, Proximal tibia, Tibia shaft, Distal tibia, Malleoli, Foot, Clavicle, Scapula

Percentages: 4%, 12%, 6%, 20%, 4%, 3%, 2%, 59%, 20%, 14%, 7%, 10%, 18%, 15%, 4%, 12%, 12%, 24%
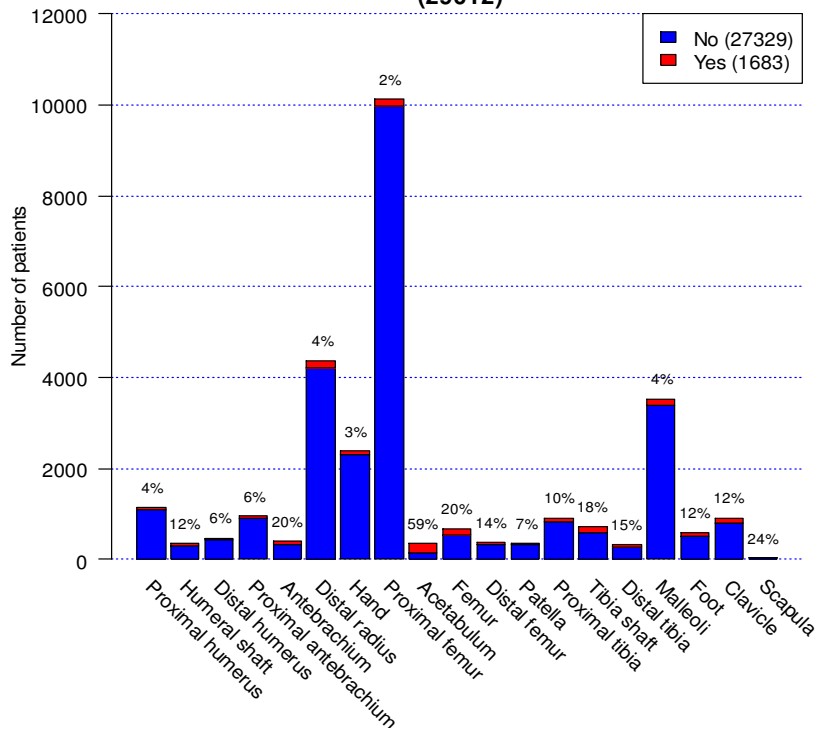
**Trauma patients by anatomical distribution
Pediatric fractures
(4984)**

Number of patients

Legend:
- No (4859)
- Yes (125)

Categories: Humerus, Radius/Ulna, Femur, Tibia/Fibula, Hand, Foot

Percentages: 2%, 1%, 19%, 5%, 2%, 7%

18
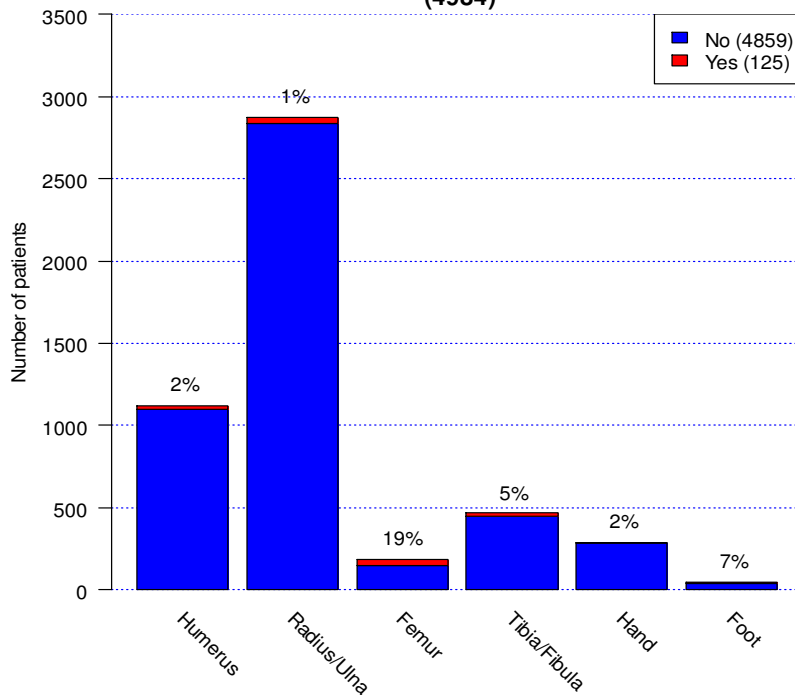
Department specific data

This section provides department specific data for all 20 participating departments. The data covers anatomical distribution for primary procedure for adults and pediatric.

Aabenraa

Anatomical distribution for Aabenraa
Primary procedure
Adult fractures
(2270)

Anatomical distribution for Aabenraa
Primary procedure
Pediatric fractures
(363)

Aalborg

Anatomical distribution for Aalborg
Primary procedure
Adult fractures
(38)

Aarhus

Anatomical distribution for Aarhus
Primary procedure
Adult fractures
(33)

Anatomical distribution for Aarhus
Primary procedure
Pediatric fractures
(6)

Bispebjerg

Anatomical distribution for Bispebjerg
Primary procedure
Adult fractures
(934)

Anatomical distribution for Bispebjerg
Primary procedure
Pediatric fractures
(2)

Esbjerg

Anatomical distribution for Esbjerg
Primary procedure
Adult fractures
(1574)

Anatomical distribution for Esbjerg
Primary procedure
Pediatric fractures
(268)

Anatomical distribution for Gentofte
Primary procedure
Adult fractures
(57)

Anatomical distribution for Gentofte
Primary procedure
Pediatric fractures
(2)

Herlev

Anatomical distribution for Herlev
Primary procedure
Adult fractures
(1470)

Anatomical distribution for Herlev
Primary procedure
Pediatric fractures
(311)

Hillerød

Anatomical distribution for Hillerød
Primary procedure
Adult fractures
(883)

Anatomical distribution for Hillerød
Primary procedure
Pediatric fractures
(234)

Holbæk

Anatomical distribution for Holbæk
Primary procedure
Adult fractures
(891)

Anatomical distribution for Holbæk
Primary procedure
Pediatric fractures
(236)

Horsens

Anatomical distribution for Horsens
Primary procedure
Adult fractures
(542)

Anatomical distribution for Horsens
Primary procedure
Pediatric fractures
(105)

Hvidovre

Anatomical distribution for Hvidovre
Primary procedure
Adult fractures
(4624)

Anatomical distribution for Hvidovre
Primary procedure
Pediatric fractures
(1384)

Kolding

Anatomical distribution for Kolding
Primary procedure
Adult fractures
(2678)

Anatomical distribution for Kolding
Primary procedure
Pediatric fractures
(630)

Køge

Anatomical distribution for Køge
Primary procedure
Adult fractures
(2230)

Anatomical distribution for Køge
Primary procedure
Pediatric fractures
(399)

Nykøbing Falster

**Anatomical distribution for Nykøbing F
Primary procedure
Adult fractures
(557)**

**Anatomical distribution for Nykøbing F
Primary procedure
Pediatric fractures
(88)**

Odense

Anatomical distribution for Odense
Primary procedure
Adult fractures
(3836)

Anatomical distribution for Odense
Primary procedure
Pediatric fractures
(502)

Randers

**Anatomical distribution for Randers
Primary procedure
Adult fractures
(349)**

**Anatomical distribution for Randers
Primary procedure
Pediatric fractures
(56)**

Rigshospitalet

Anatomical distribution for Rigshospitalet
Primary procedure
Adult fractures
(1354)

Number of patients

5% 3% 3% 4% 3% 6% 5% 4% 12% 5% 3% 1% 5% 7% 4% 10% 14% 5% 1%

Proximal humerus
Humeral shaft
Distal humerus
Proximal antebrachium
Antebrachium
Distal radius
Hand
Proximal femur
Acetabulum
Femur
Distal femur
Patella
Proximal tibia
Tibia shaft
Distal tibia
Malleoli
Foot
Clavicle
Scapula

Anatomical distribution for Rigshospitalet
Primary procedure
Pediatric fractures
(163)

Number of patients

22% 44% 17% 10% 4% 3%

Humerus
Radius/Ulna
Femur
Tibia/Fibula
Hand
Foot

Slagelse

Anatomical distribution for Slagelse
Primary procedure
Adult fractures
(2851)

Anatomical distribution for Slagelse
Primary procedure
Pediatric fractures
(519)

Vejle

Anatomical distribution for Vejle
Primary procedure
Adult fractures
(235)

Anatomical distribution for Vejle
Primary procedure
Pediatric fractures
(35)

Anatomical distribution for Viborg
Primary procedure
Adult fractures
(763)

Anatomical distribution for Viborg
Primary procedure
Pediatric fractures
(186)

Focus area - Clavicle

Fracture classification for Shoulder fractures
(958)

Method of osteosynthesis Clavicle fractures
Primary procedure
(913)

Indication for reoperations of Clavicle fractures
(56)

Surgeon level for Clavicle fractures
(917)

Level of supervision for Clavicle fractures
(886)

Level of supervision for interns and residents
Clavicle fractures
(282)

Legend:
- Below attending (30) — red
- Attending or above (166) — green
- Unsupervised (86) — blue

Surgical delay for Clavicle fractures
(577)

17 %   22 %   20 %   16 %   12 %   8 %   5 %

Number of patients

Hours
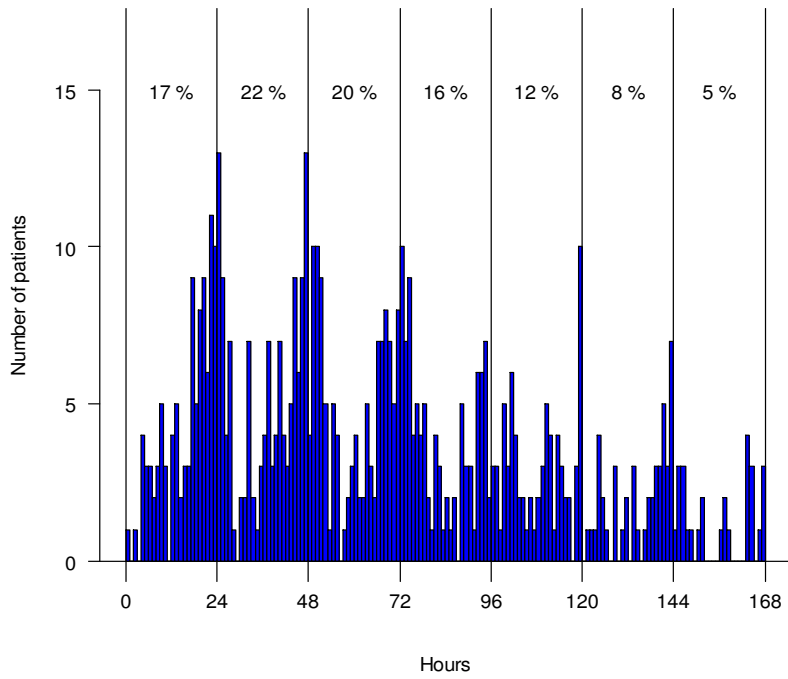
(Proportion of patients operated in 24 hour intervals)

Time of primary Clavicle procedure
Adult fractures
(917)

Time of day

42
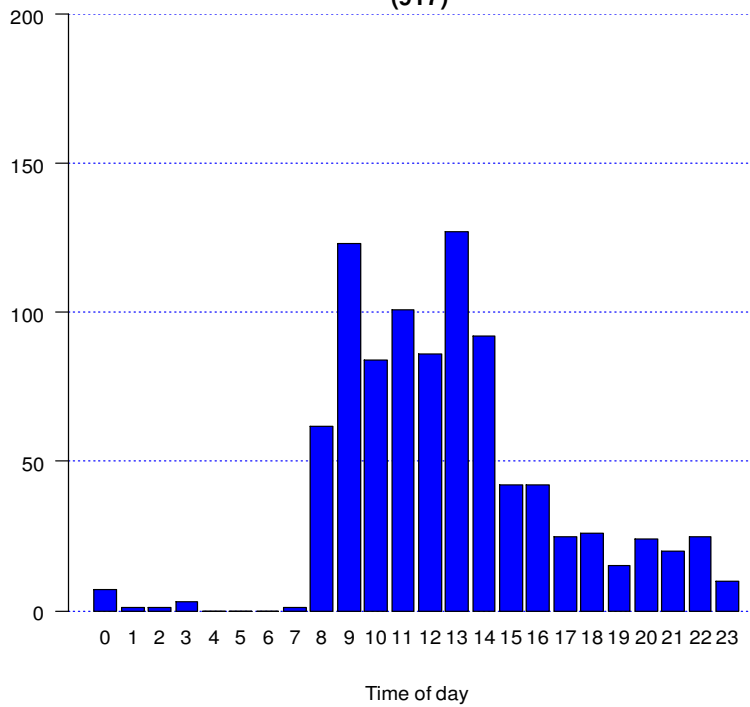
Survival for primary procedure with reoperation due to any reason
Clavicle fractures
(917)
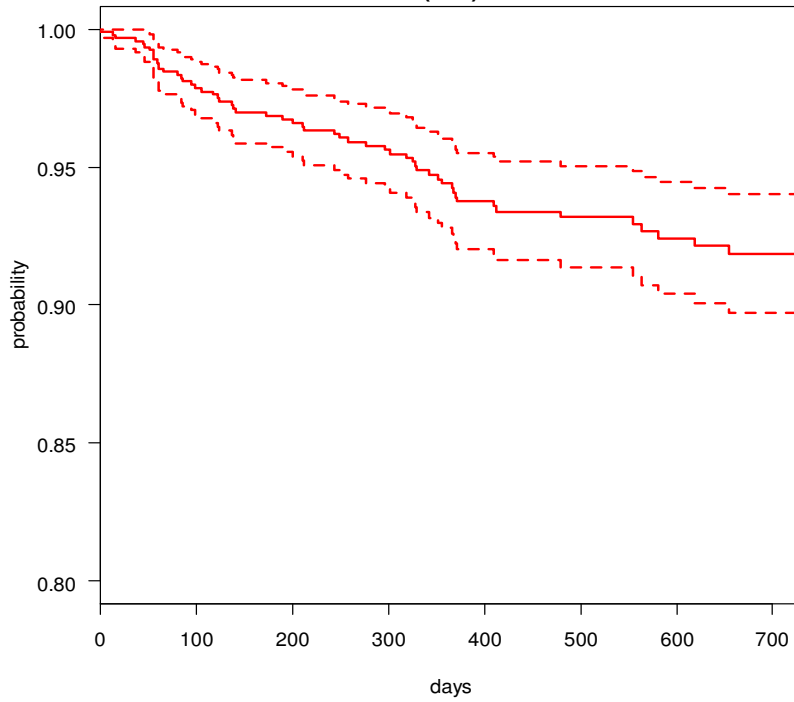
Survival for primary procedure with reoperation due to any reason
except pain and discomfort from surgical hardware
Clavicle fractures
(917)

Adult

Proximal Humerus

Method of osteosynthesis proximal humerus fractures (1136)

**Indication for reoperations of proximal humerus fractures (114)**
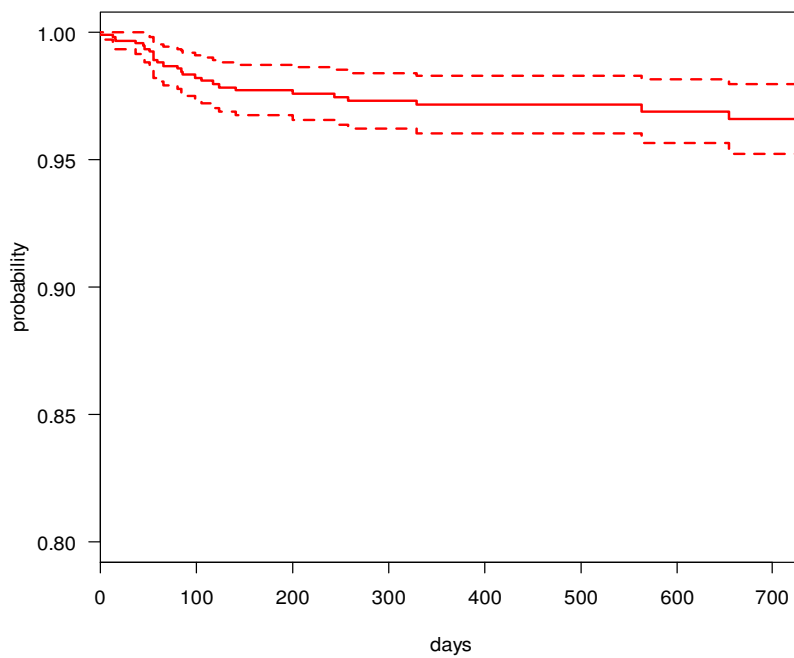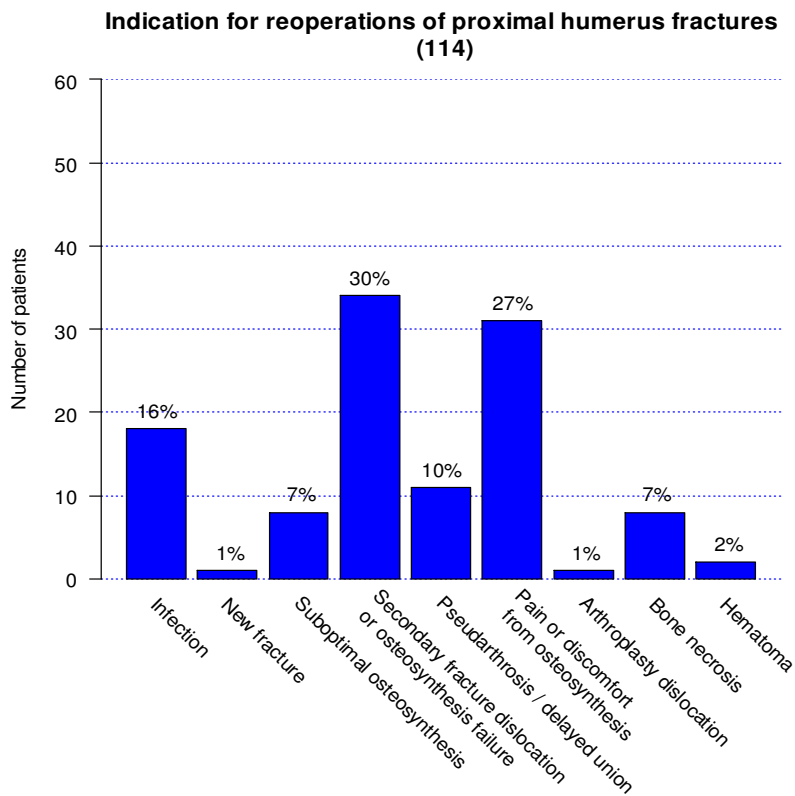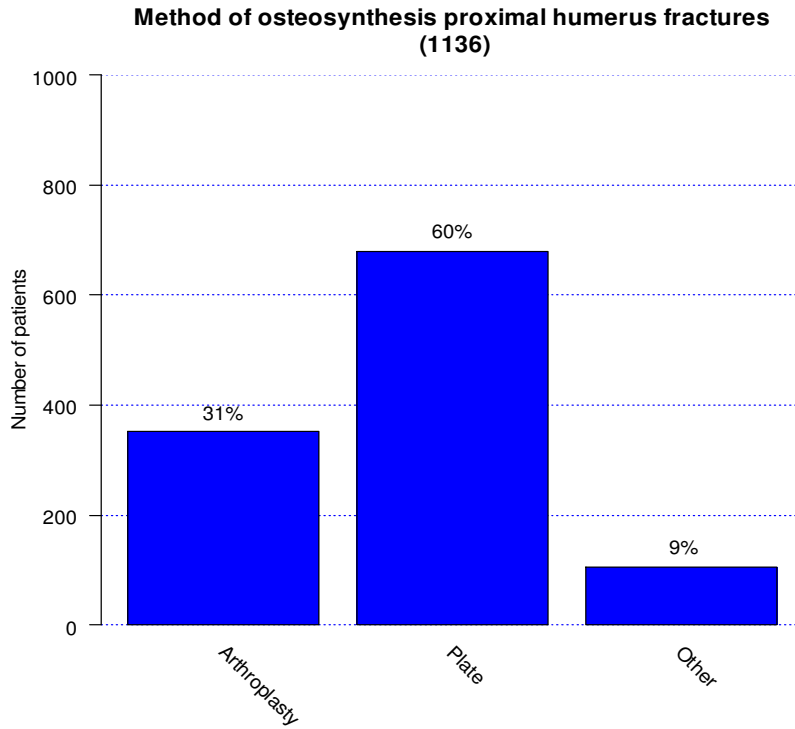
Surgeon level for proximal humerus fractures (1147)
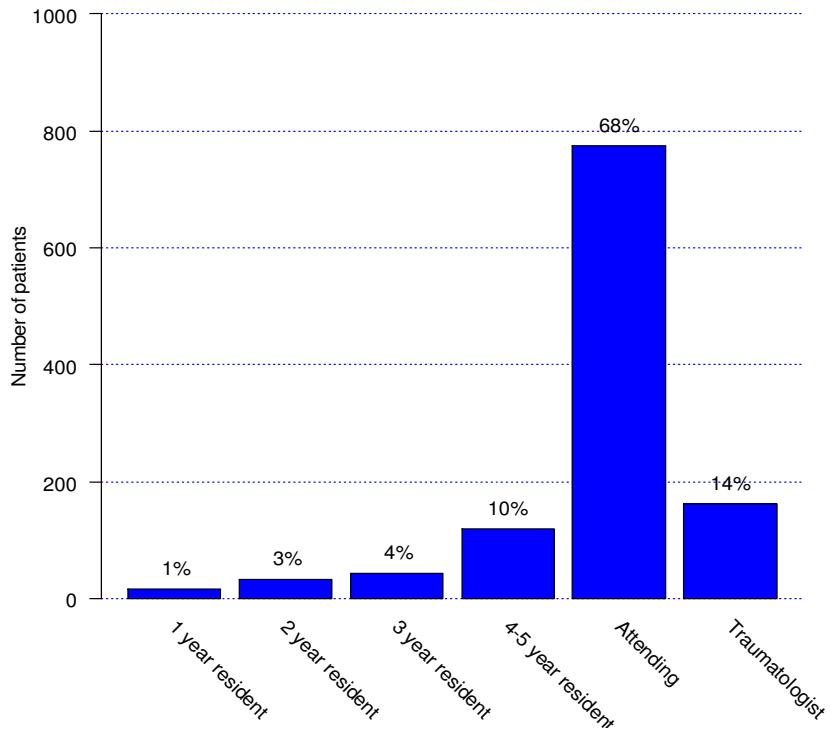
Level of supervision for proximal humerus fractures (1081)
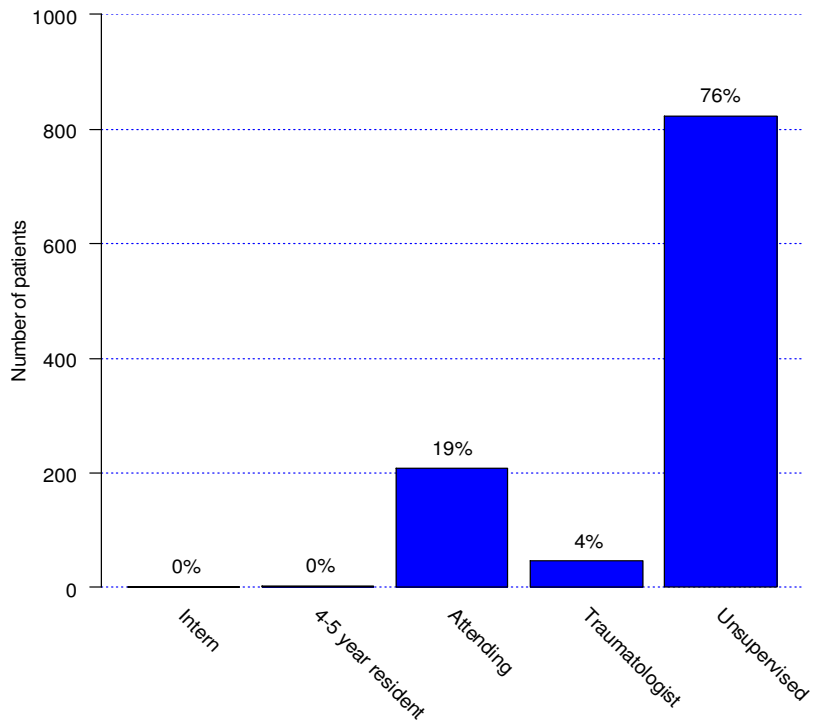
Level of supervision for interns and residents
proximal humerus fractures
(210)

Legend:
- Below attending (3)
- Attending or above (176)
- Unsupervised (31)

Y-axis: Number of patients

Data labels:
- 1 year resident: 0%, 94%, 6%
- 2 year resident: 9%, 91%, 0%
- 3 year resident: 0%, 95%, 5%
- 4-5 year resident: 0%, 76%, 24%
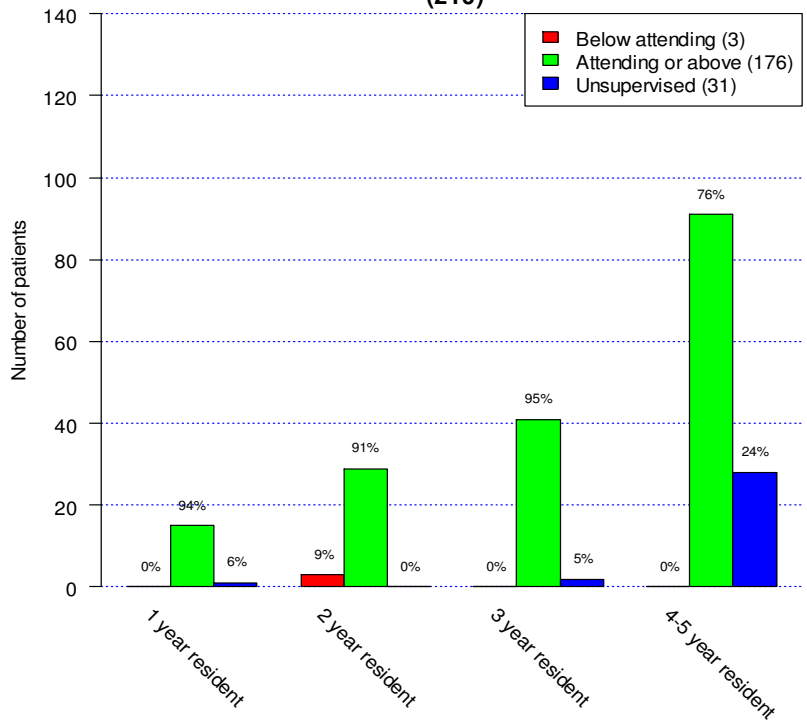
Surgical delay for proximal humerus fractures
(794)
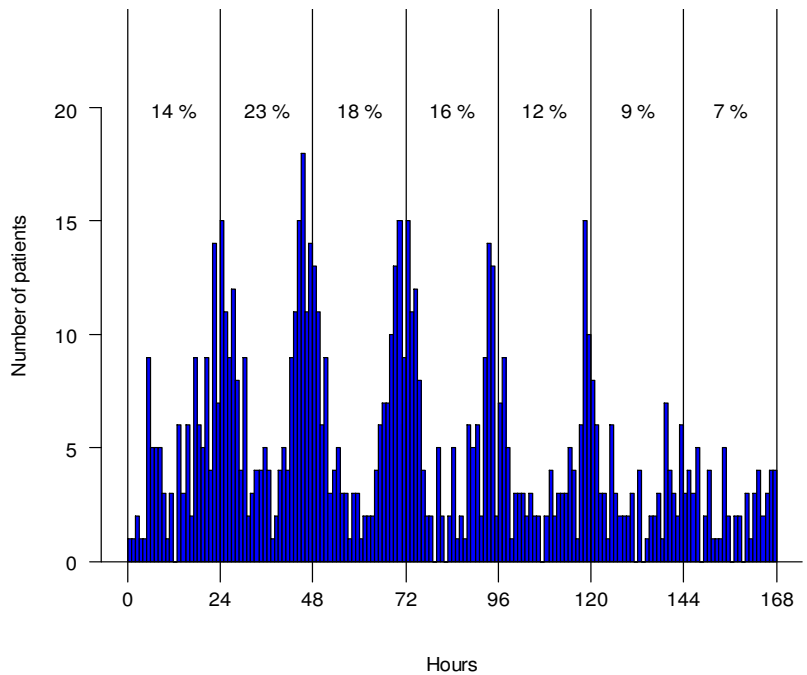
Y-axis: Number of patients

X-axis: Hours (0, 24, 48, 72, 96, 120, 144, 168)

Interval labels: 14 %, 23 %, 18 %, 16 %, 12 %, 9 %, 7 %

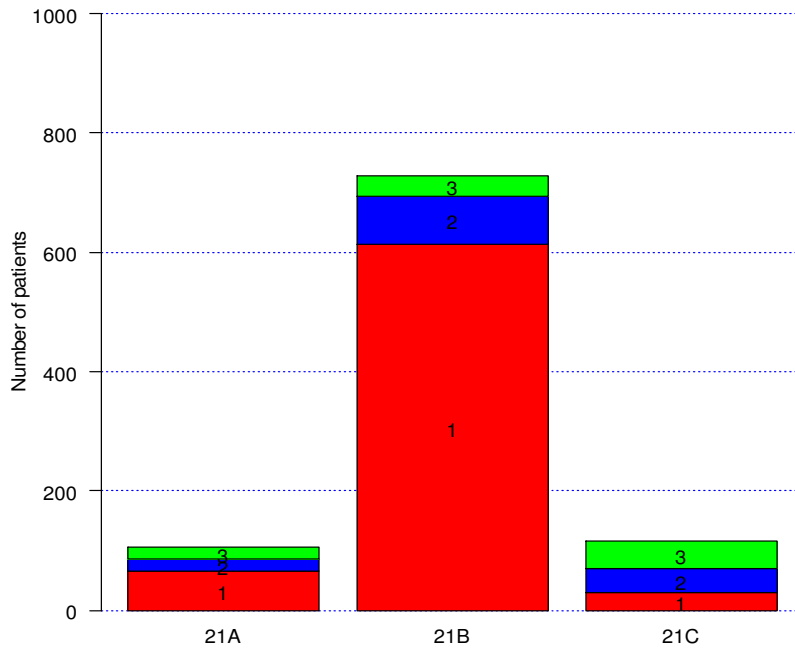(Proportion of patients operated in 24 hour intervals)

Survival for primary procedure with reoperation due to any reason
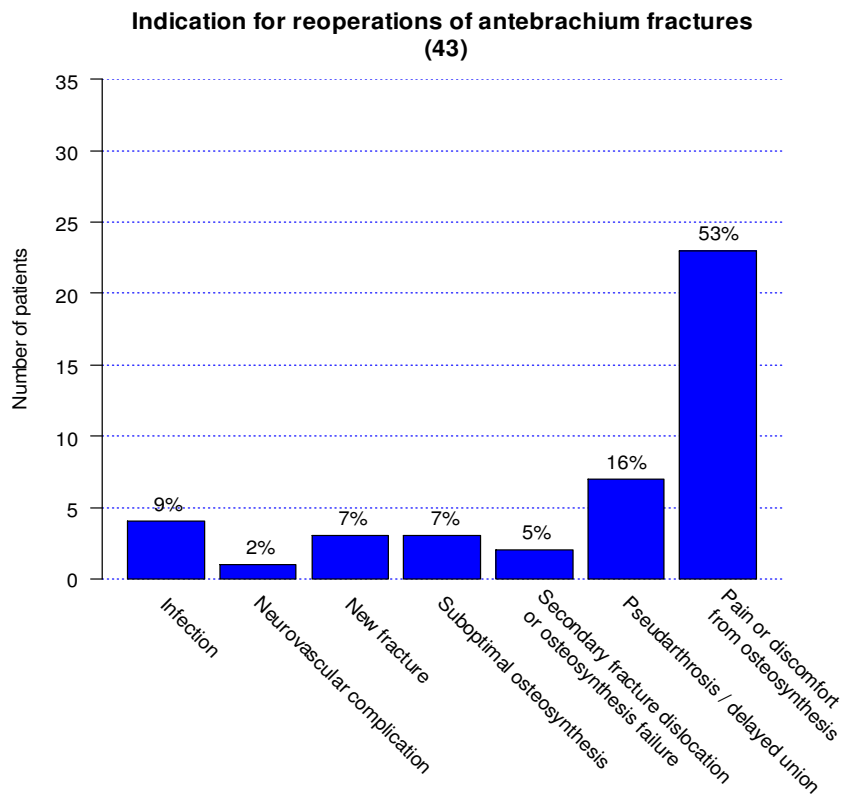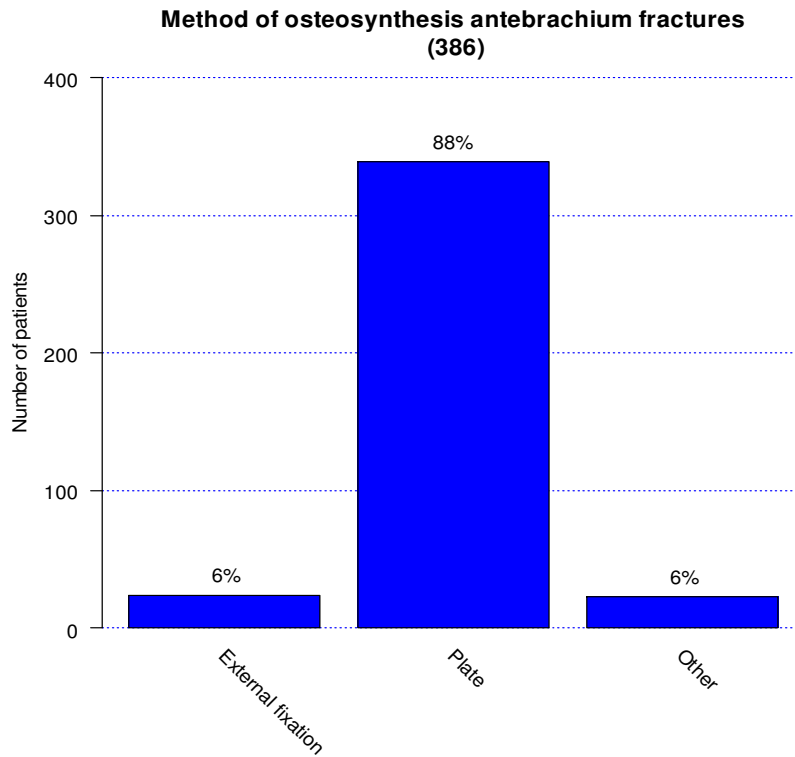**proximal humerus fractures**
(1147)
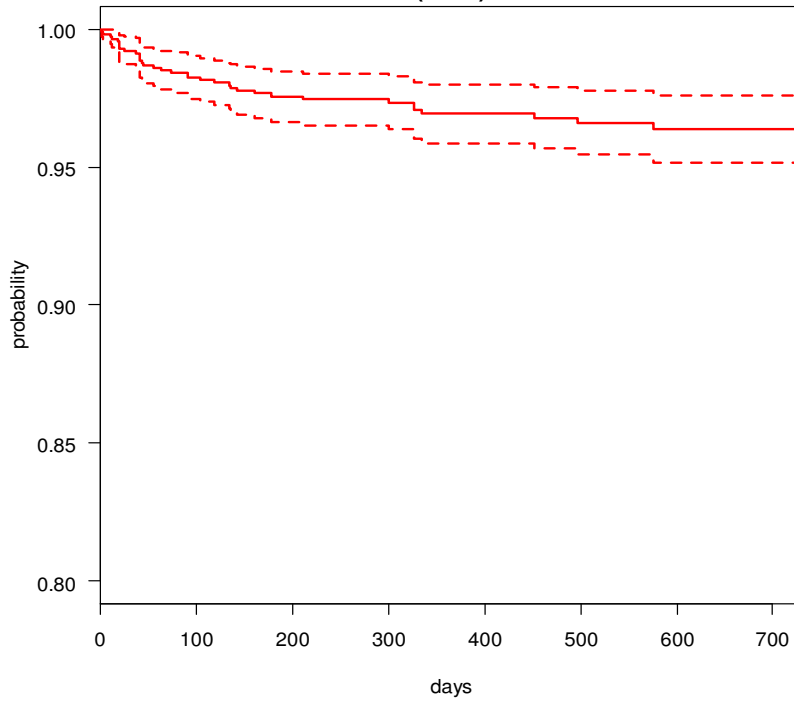
Survival for primary procedure with reoperation due to any reason
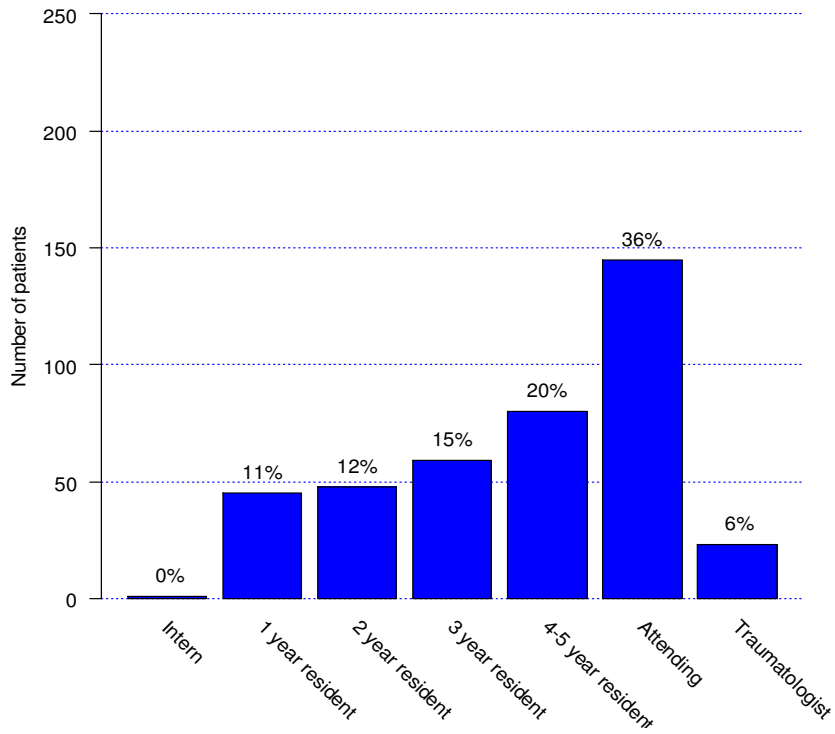**except pain and discomfort from surgical hardware**
proximal humerus fractures
(1147)
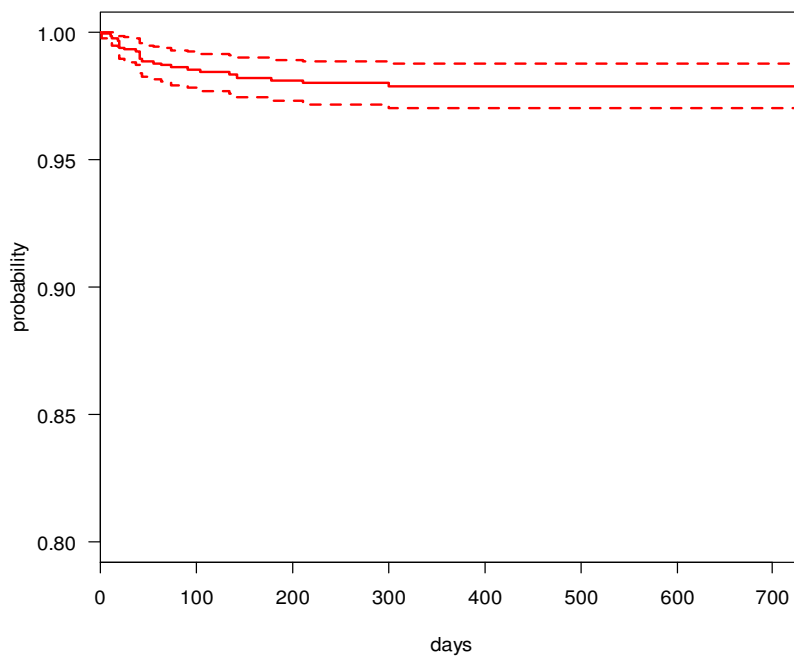
Fracture classification for proximal humerus fractures (1147)

Method of osteosynthesis humeral shaft fractures (347)

Indication for reoperations of humeral shaft fractures (47)
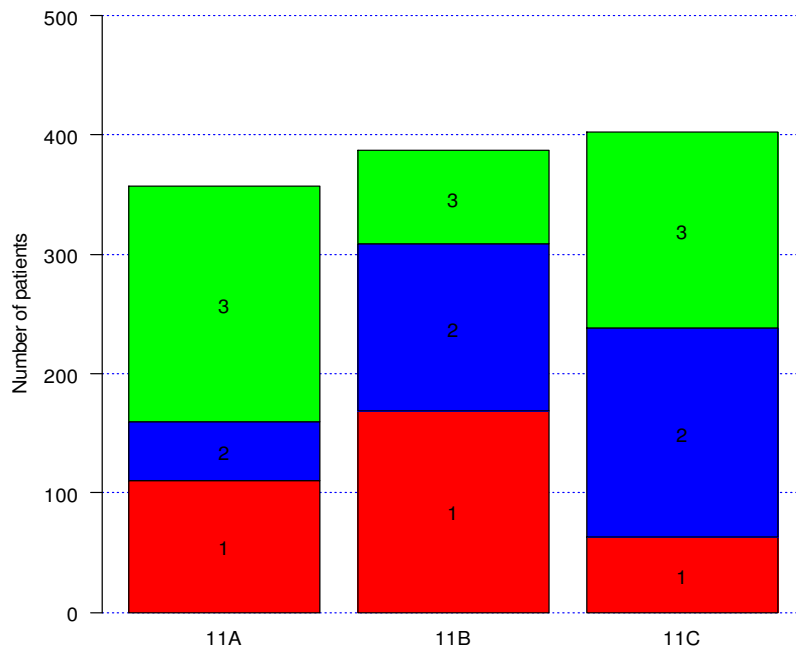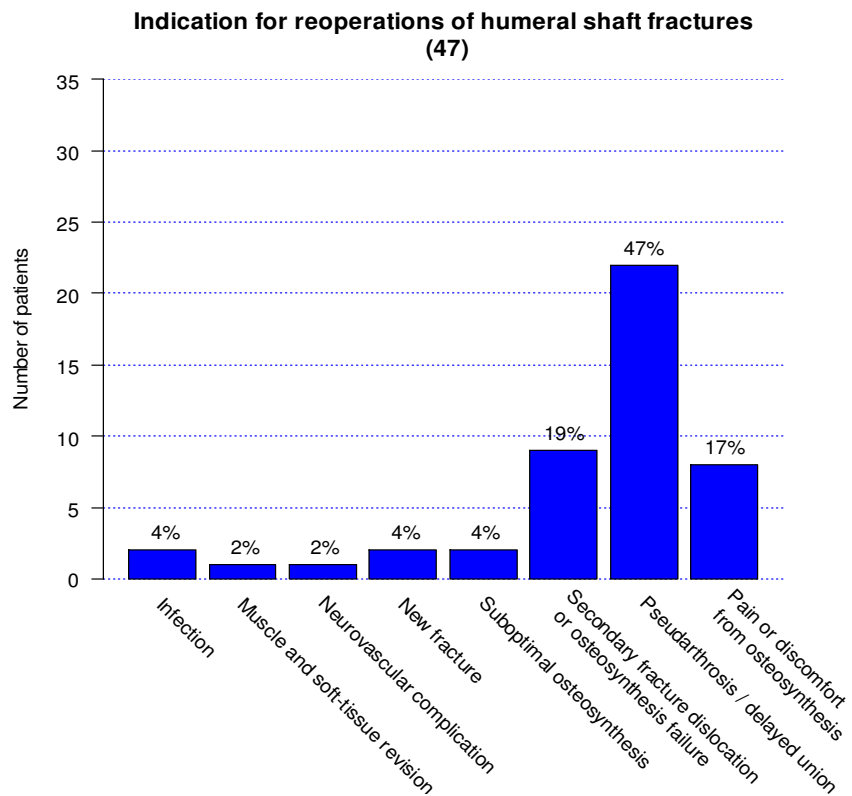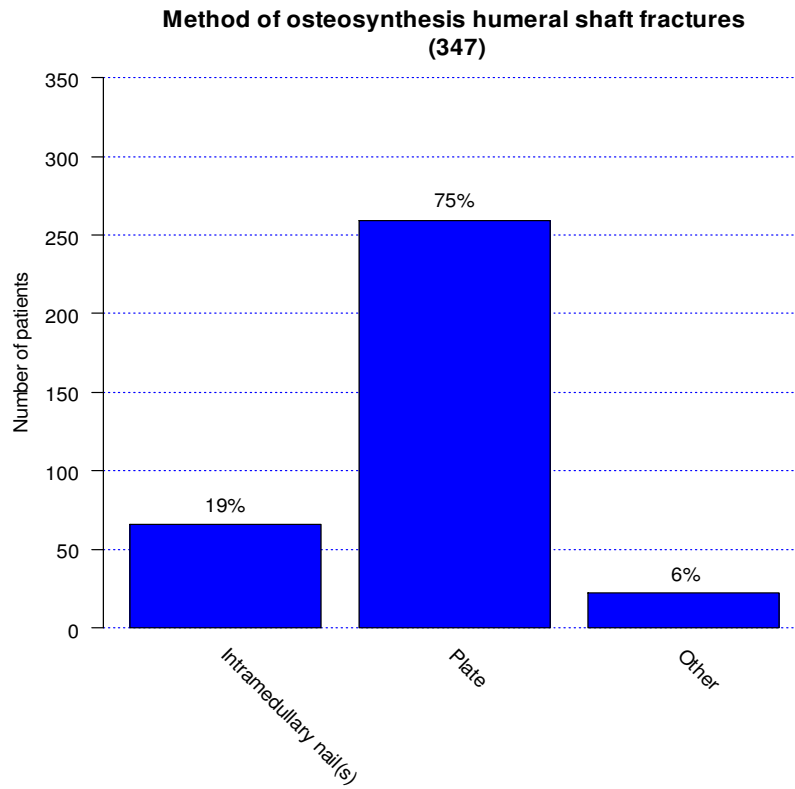
Surgeon level for humeral shaft fractures
(351)
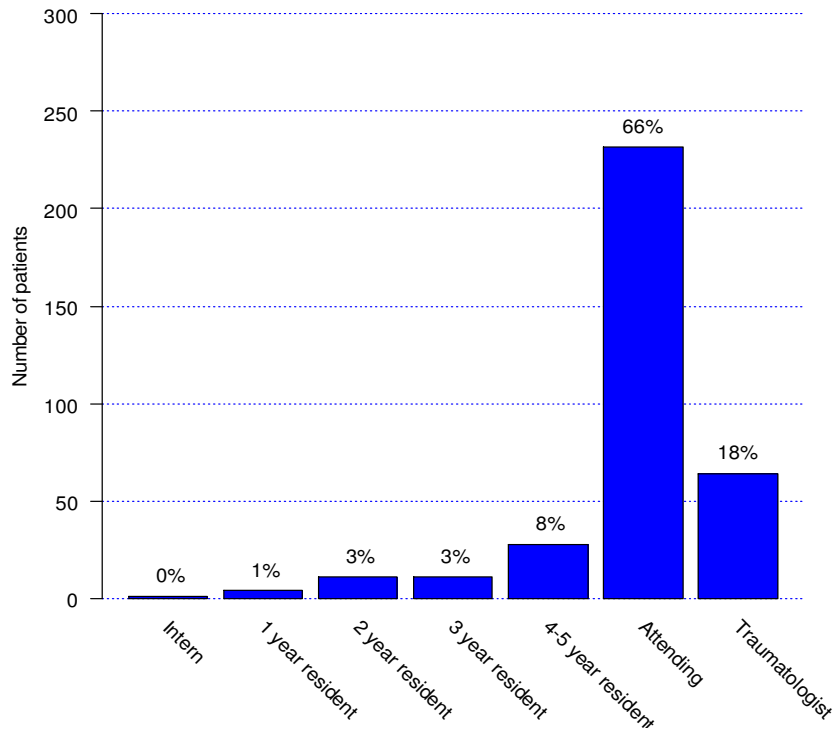
Level of supervision for humeral shaft fractures
(340)
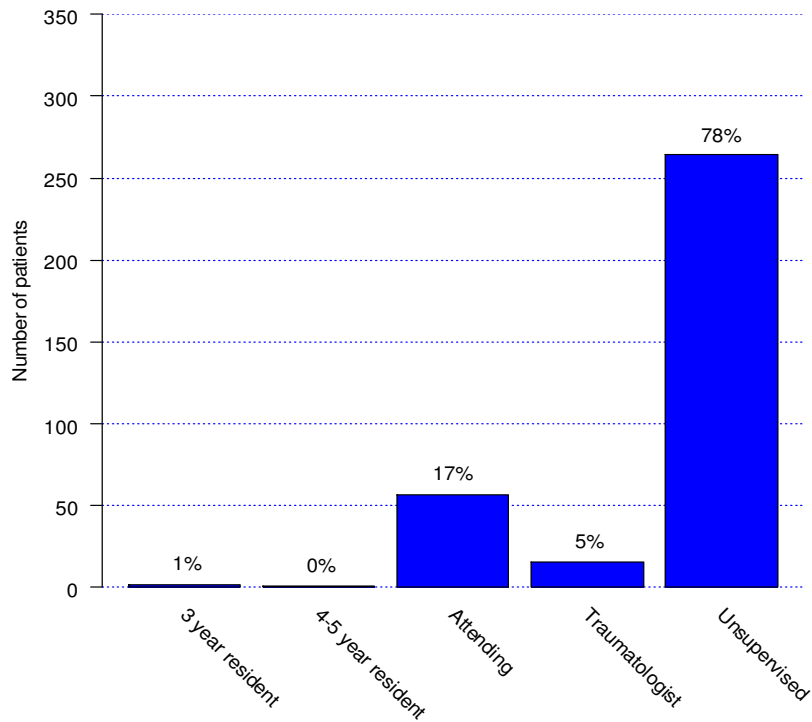
Level of supervision for interns and residents humeral shaft fractures
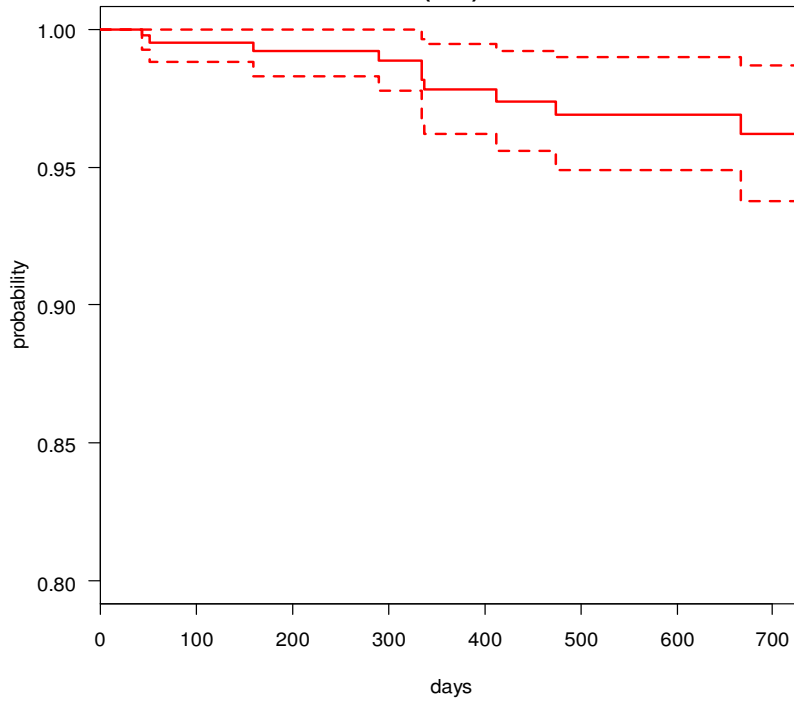## (55)
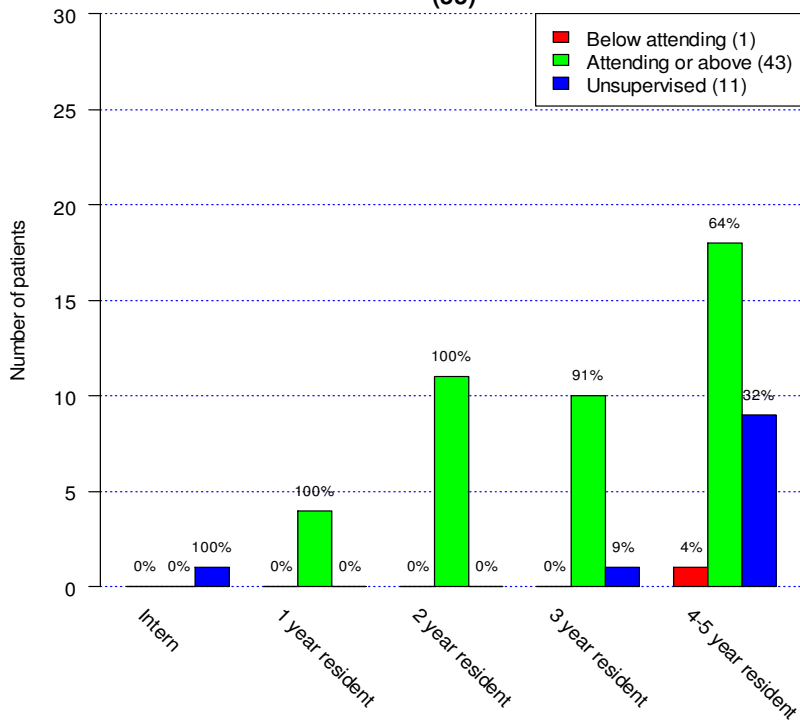
Surgical delay for humeral shaft fractures
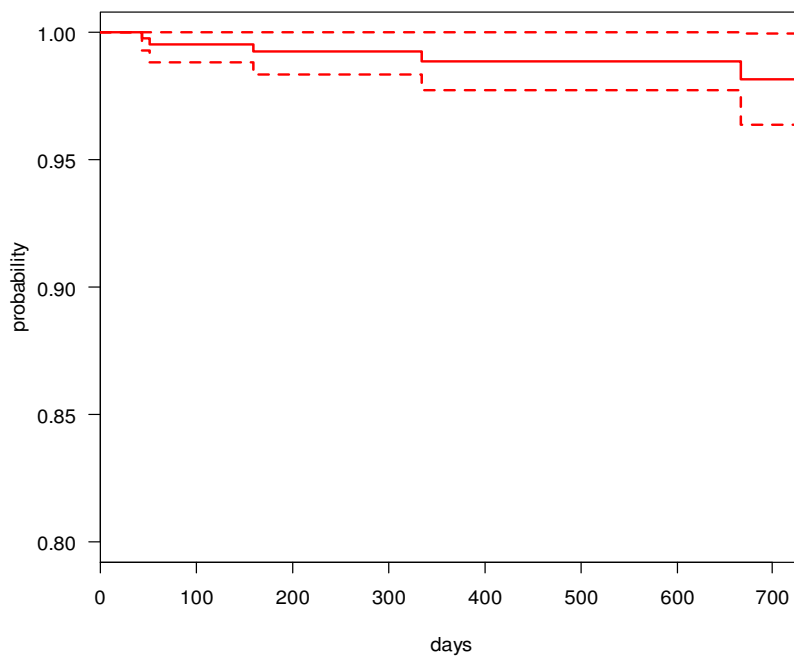## (201)
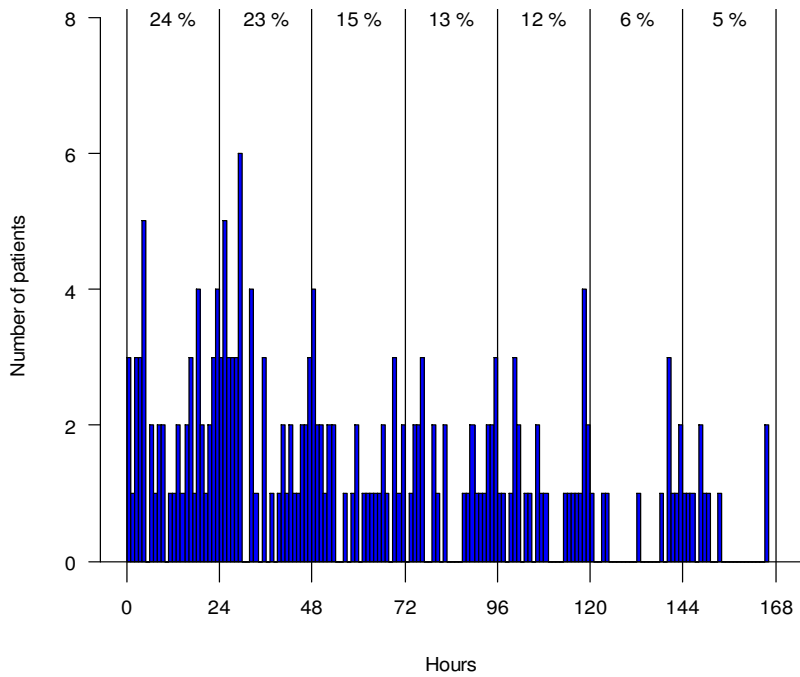
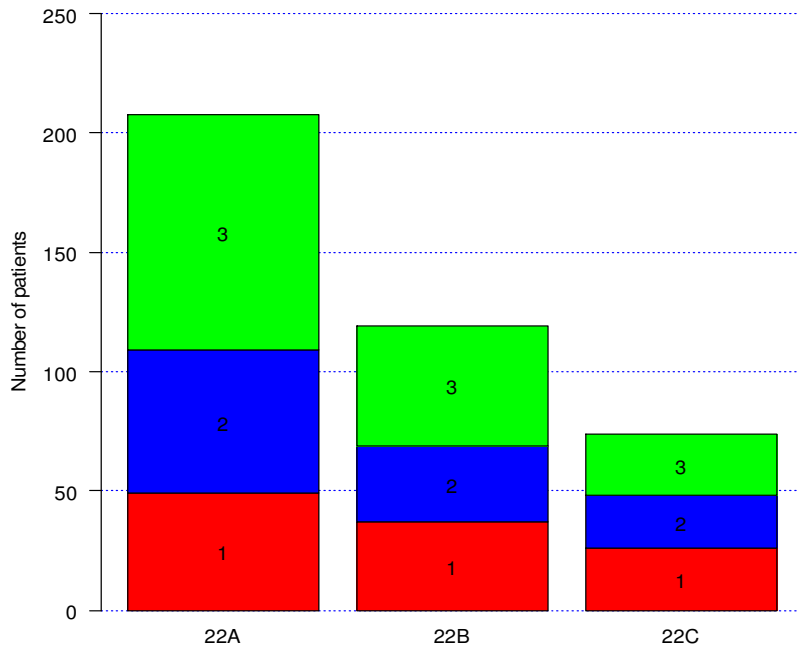(Proportion of patients operated in 24 hour intervals)

51

**Survival for primary procedure with reoperation due to any reason
humeral shaft fractures
(351)**
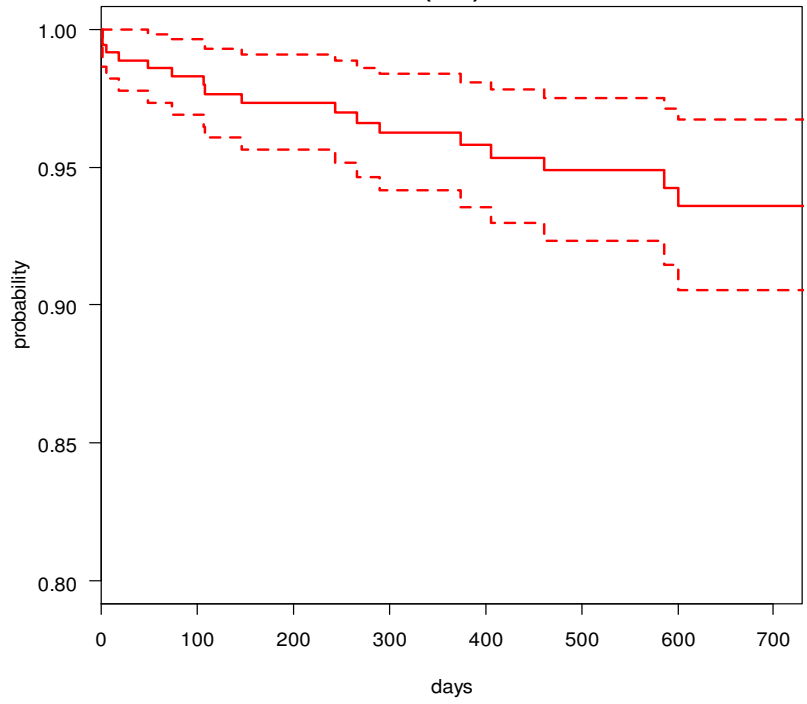
**Survival for primary procedure with reoperation due to any reason
except pain and discomfort from surgical hardware
humeral shaft fractures
(351)**
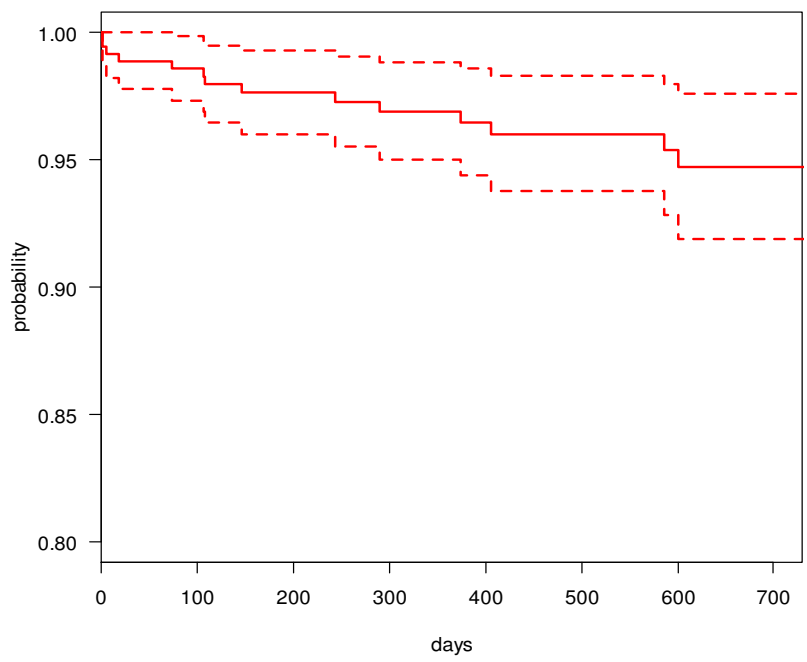
Fracture classification for humeral shaft fractures (351)

Distal Humerus

Method of osteosynthesis distal humerus fractures (462)

Bar chart — Number of patients (y-axis, 0 to 400):
- External fixation: 6%
- Plate: 72%
- Screw(s): 12%
- Other: 11%

Indication for reoperations of distal humerus fractures (85)

Bar chart — Number of patients (y-axis, 0 to 60):
- Infection: 12%
- Muscle and soft-tissue revision: 2%
- Neurovascular complication: 2%
- New fracture: 4%
- Suboptimal osteosynthesis: 6%
- Secondary fracture dislocation or osteosynthesis failure: 16%
- Pseudarthrosis / delayed union: 6%
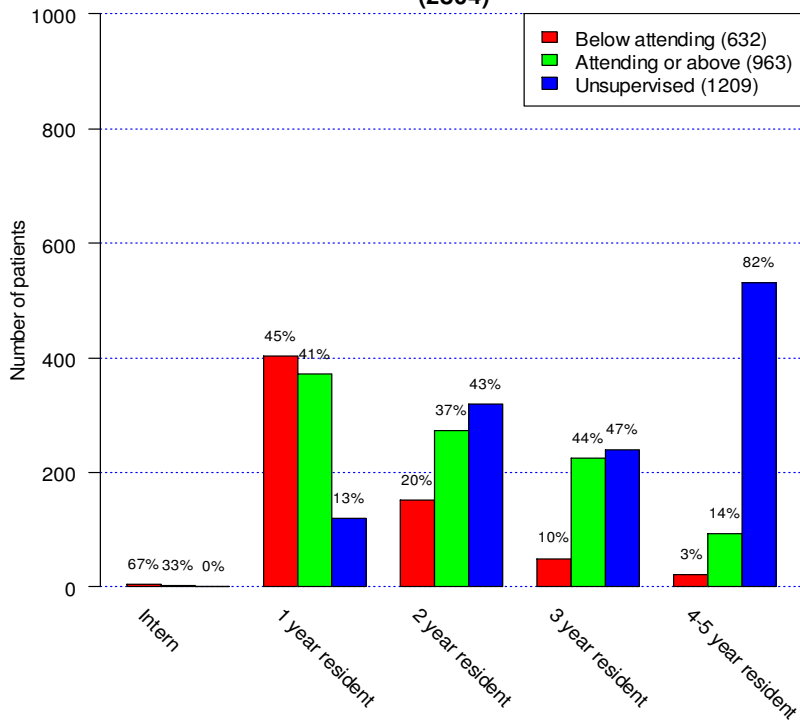- Pain or discomfort from osteosynthesis: 52%

Surgeon level for distal humerus fractures
(466)
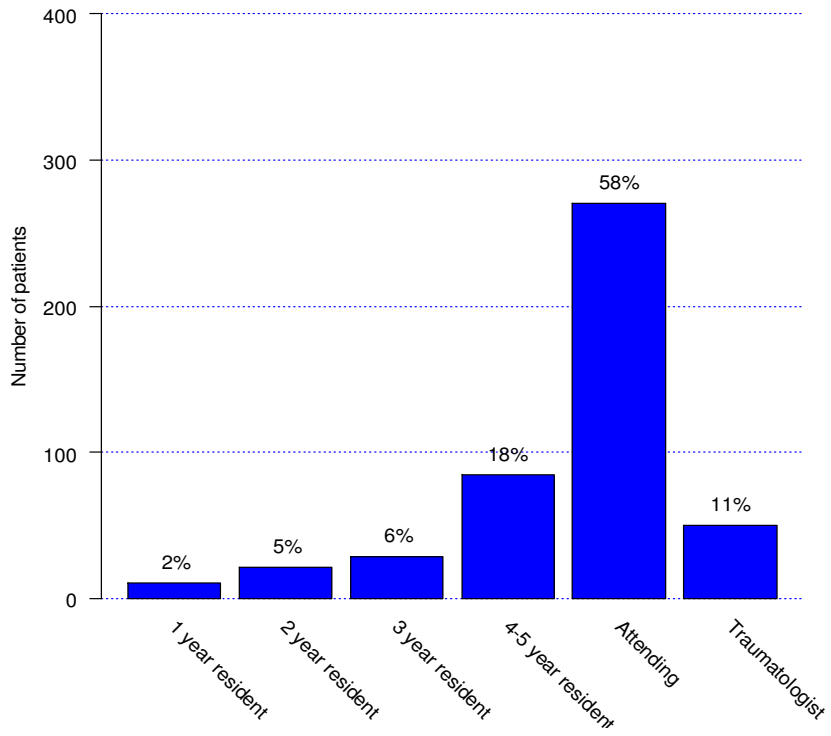
Level of supervision for distal humerus fractures
(454)
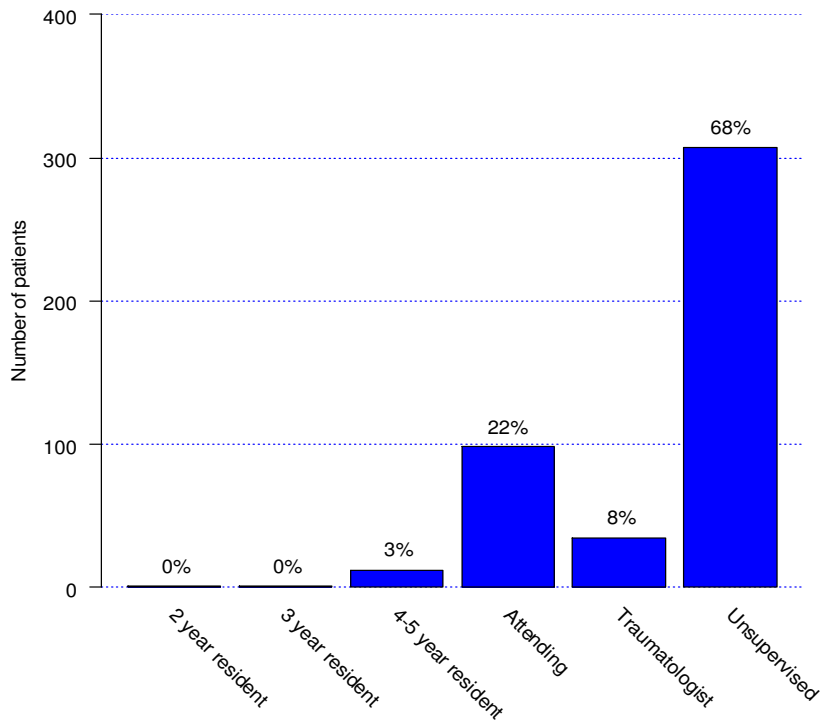
Level of supervision for interns and residents
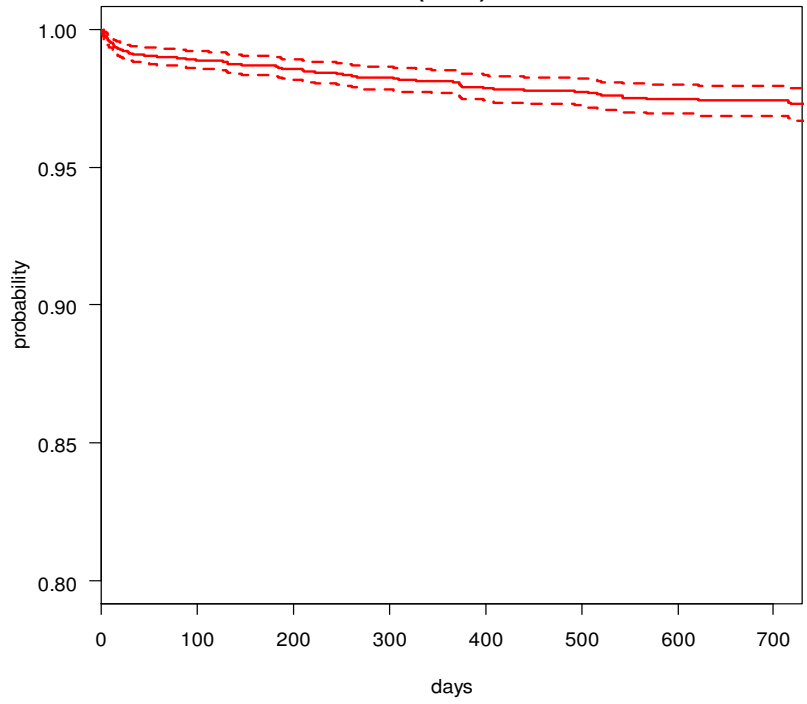## distal humerus fractures
(145)
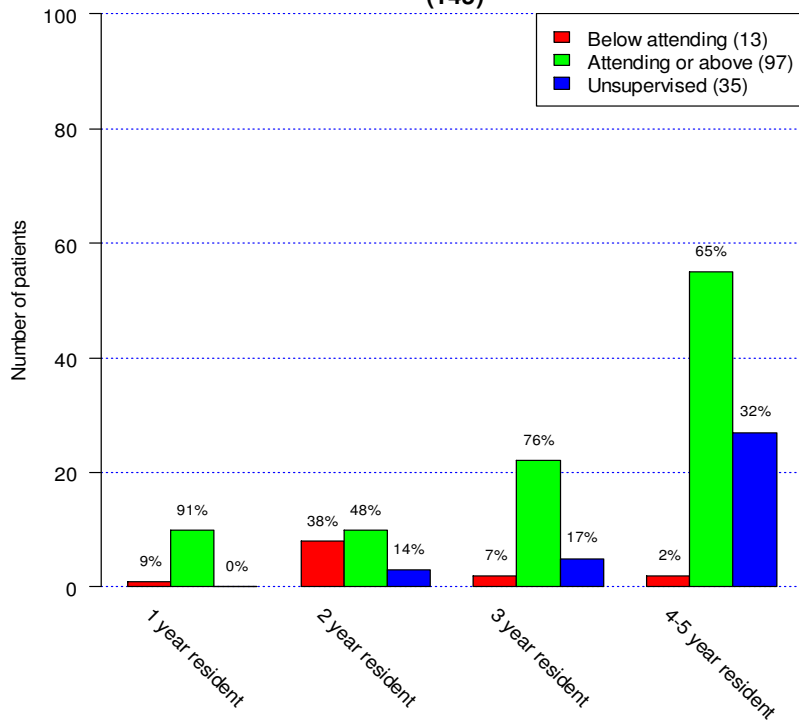
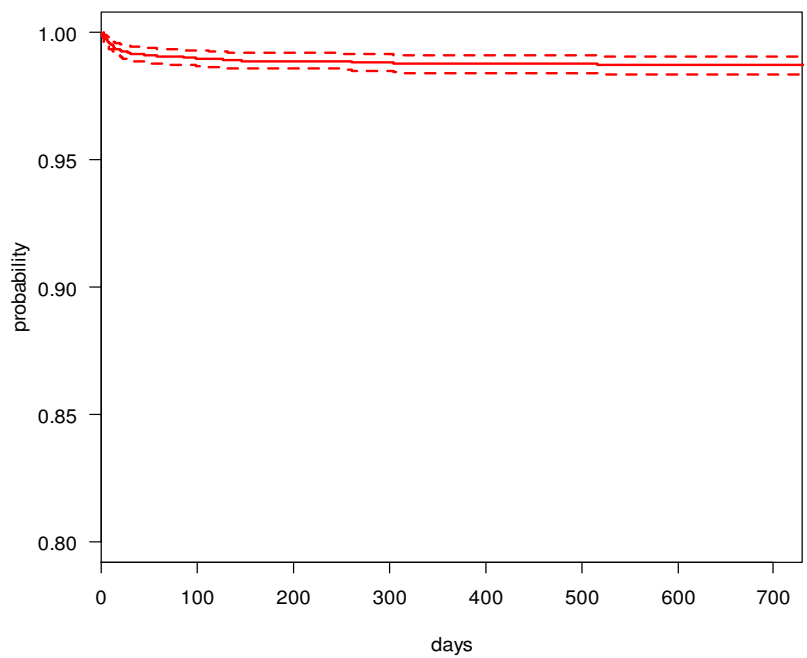## Surgical delay for distal humerus fractures
(392)
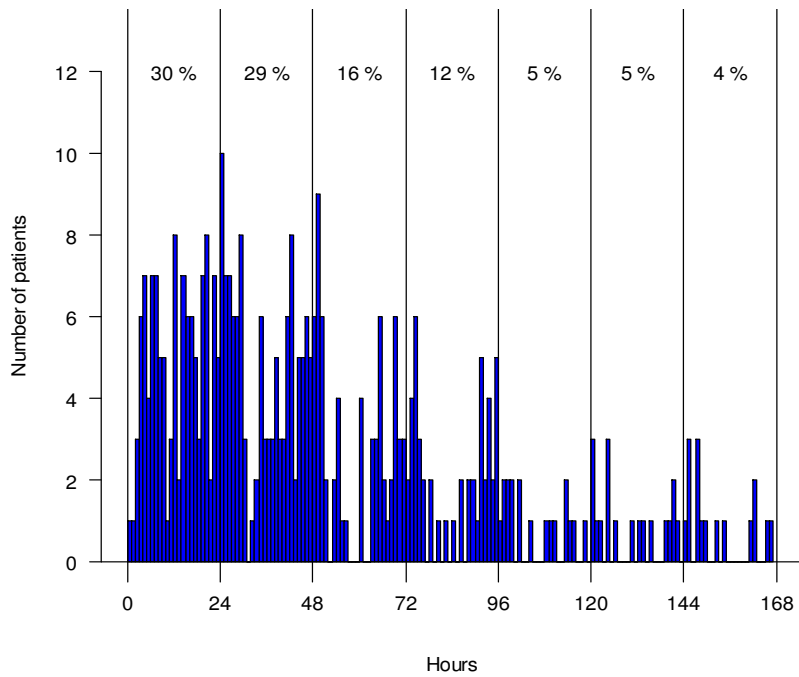
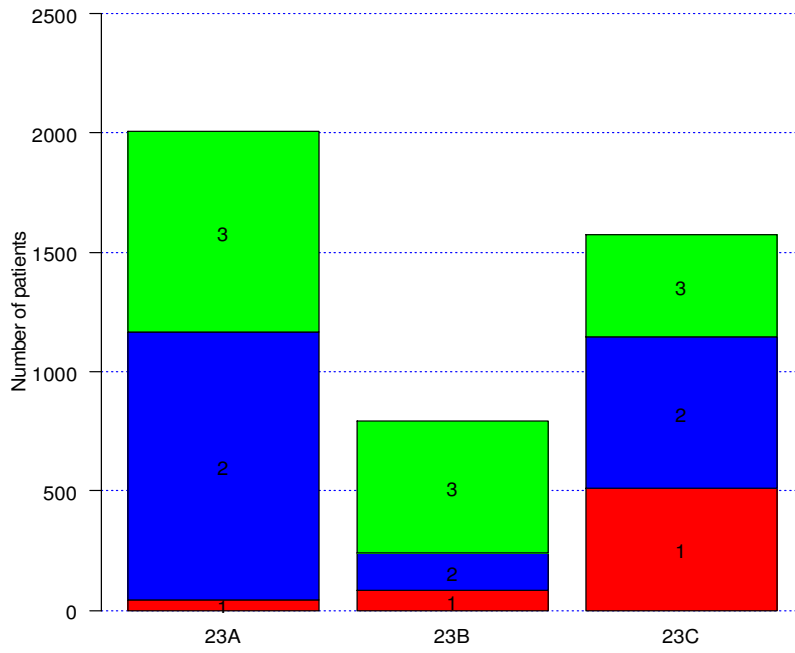(Proportion of patients operated in 24 hour intervals)

**Survival for primary procedure with reoperation due to any reason
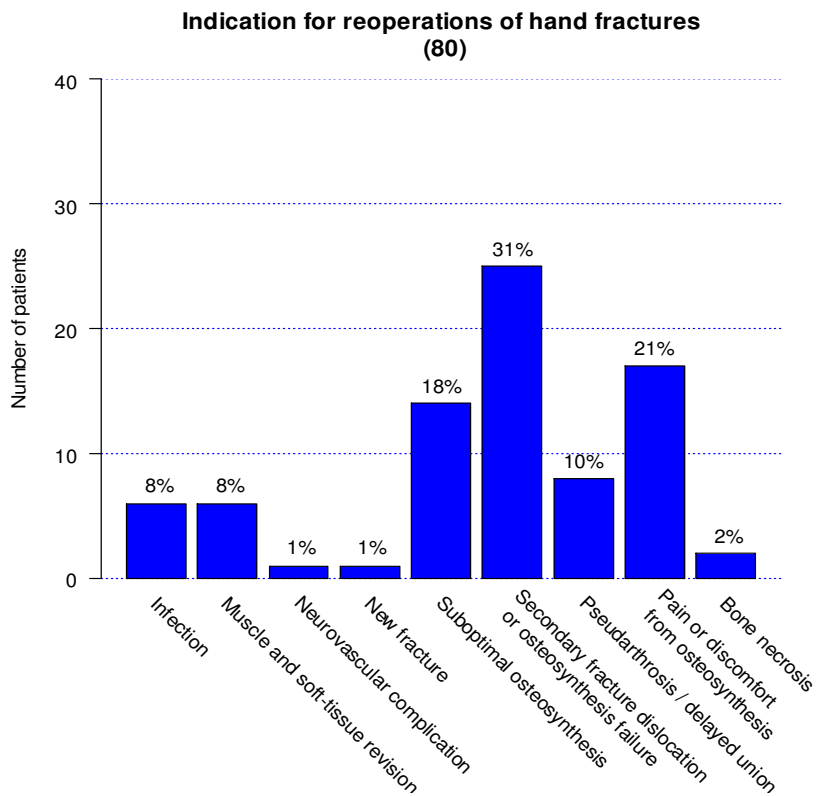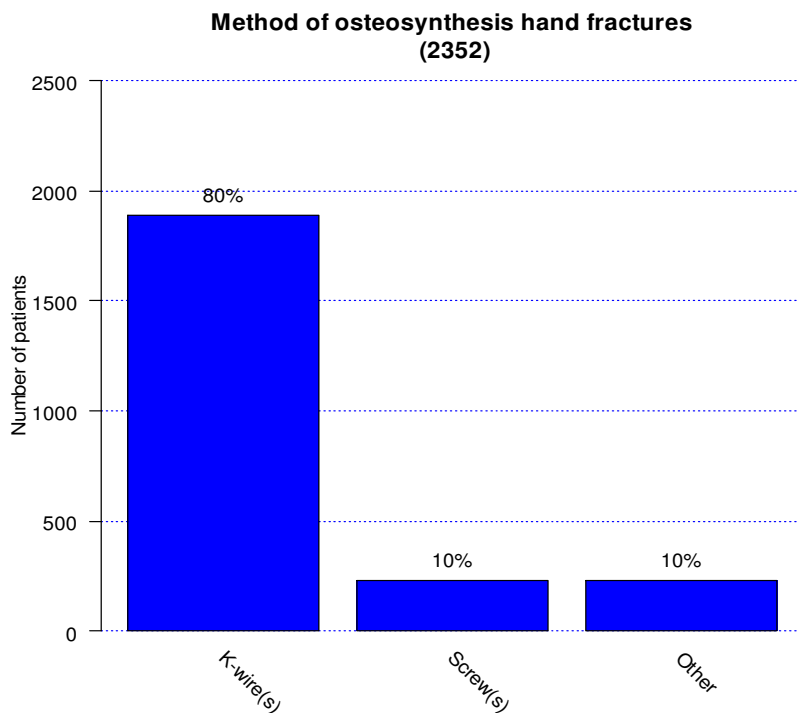distal humerus fractures
(468)**
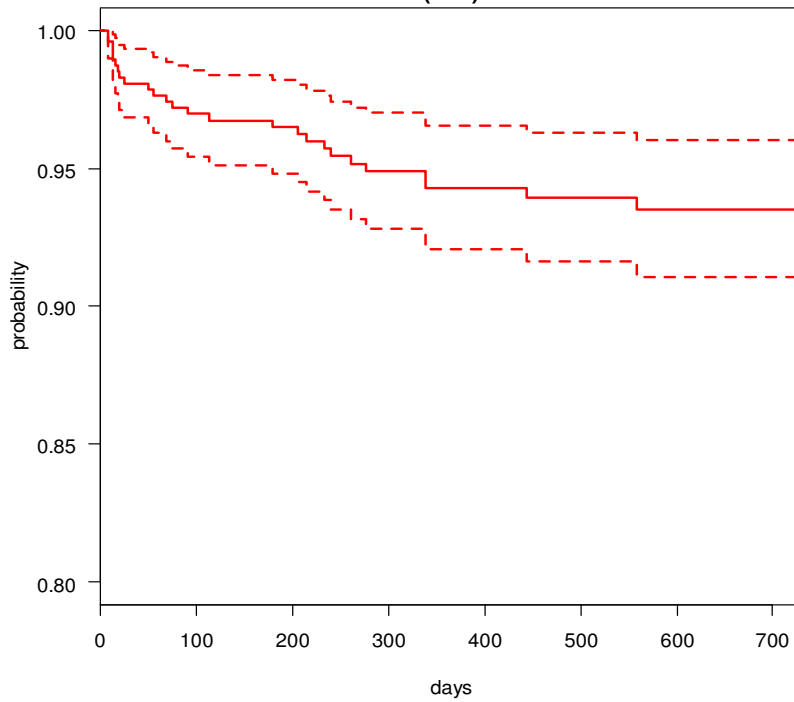
**Survival for primary procedure with reoperation due to any reason
except pain and discomfort from surgical hardware
distal humerus fractures
(468)**
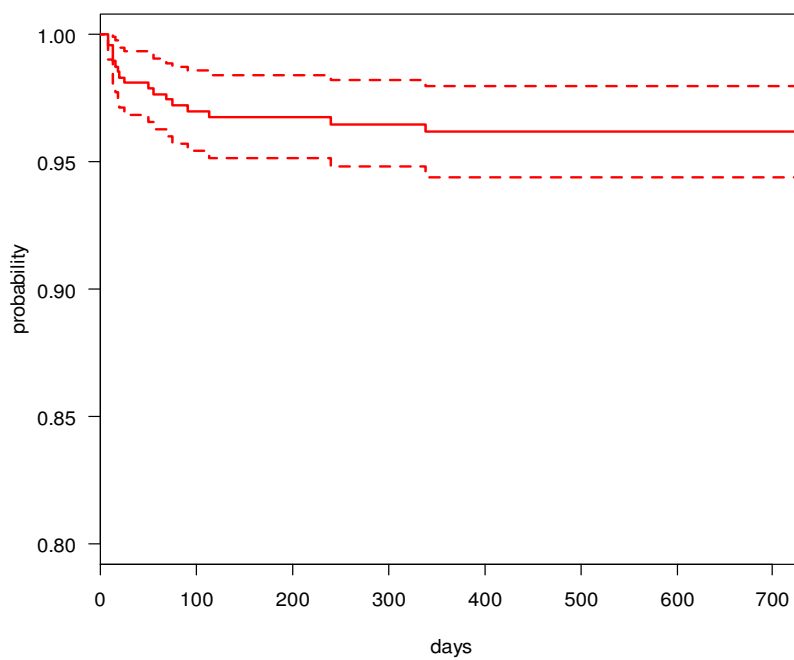
Fracture classification for distal humerus fractures (468)

Proximal antebrachium

Method of osteosynthesis proximal antebrachium fractures (937)

Indication for reoperations of proximal antebrachium fractures (172)
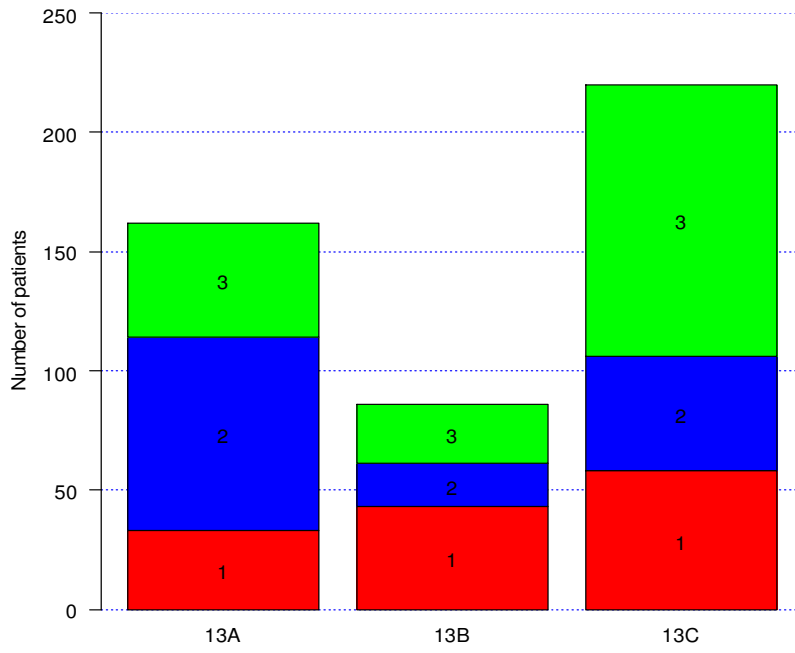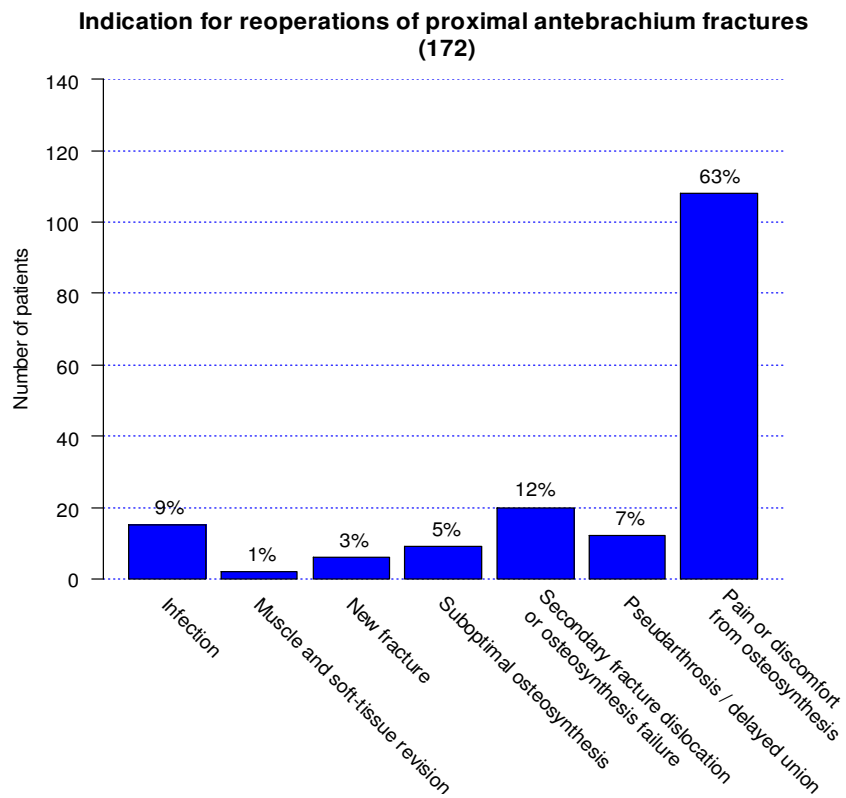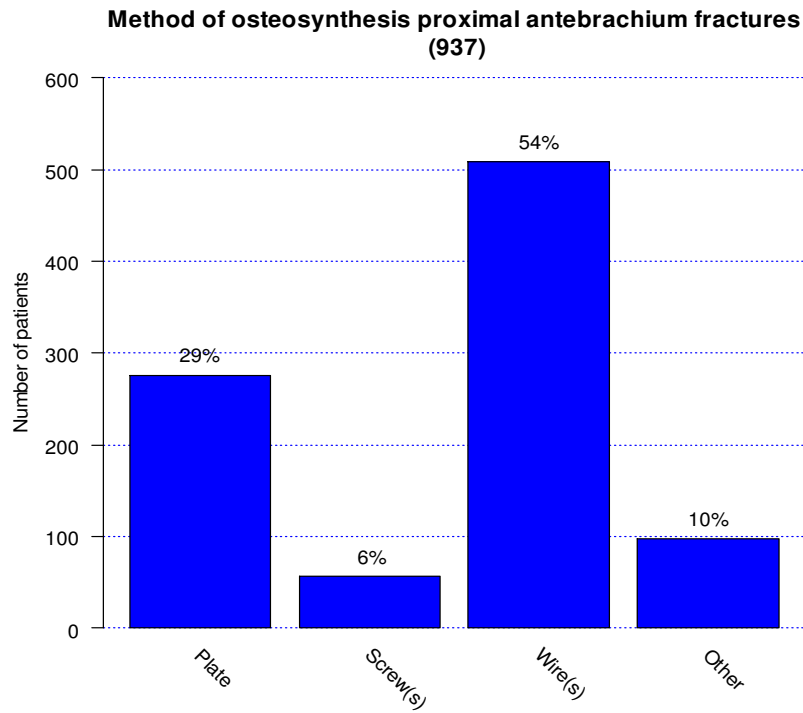
Surgeon level for proximal antebrachium fractures (948)
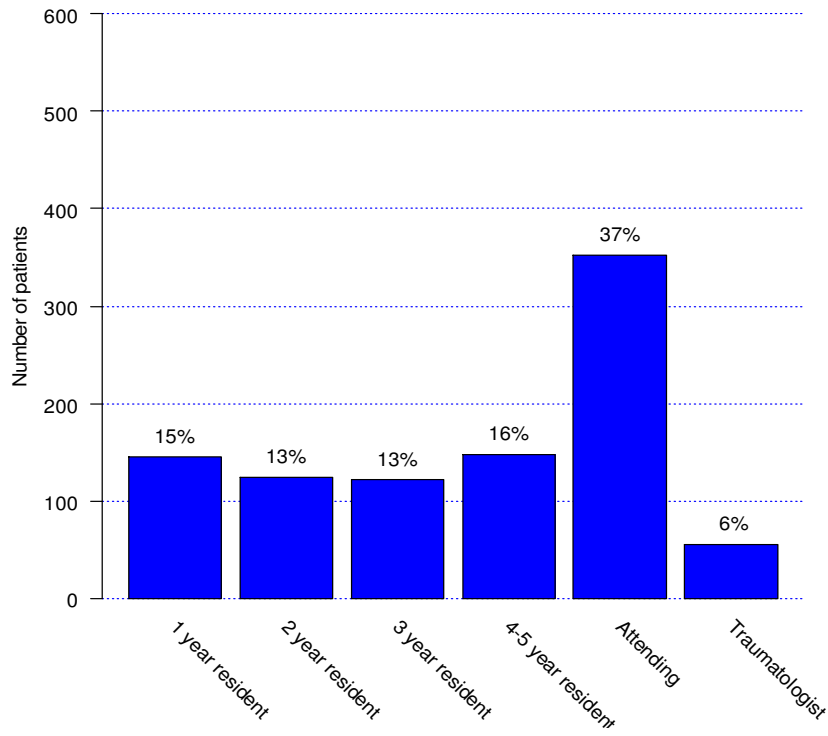
Level of supervision for proximal antebrachium fractures (927)
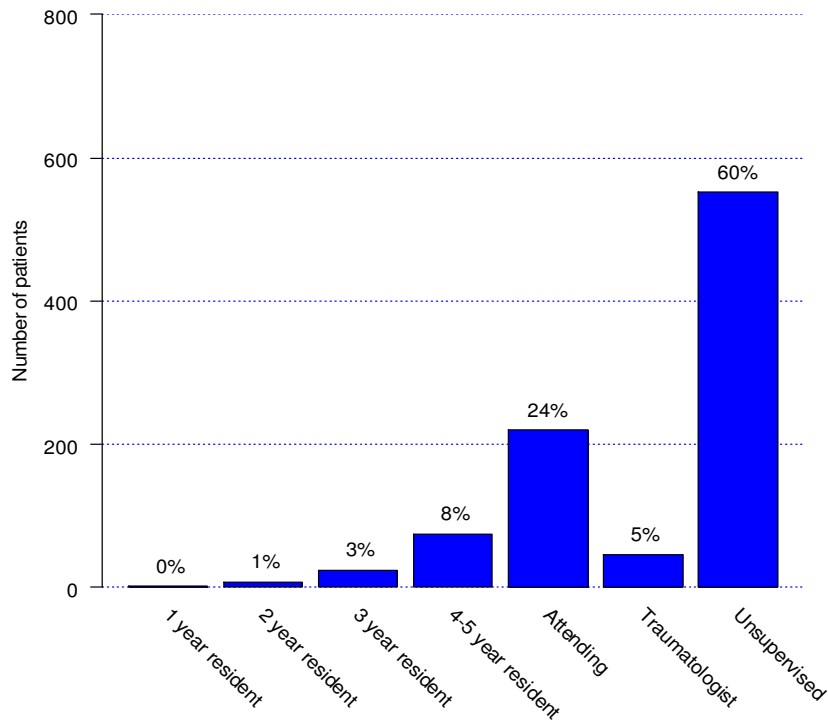
**Level of supervision for interns and residents
proximal antebrachium fractures
(540)**

Legend:
- Below attending (109)
- Attending or above (240)
- Unsupervised (191)
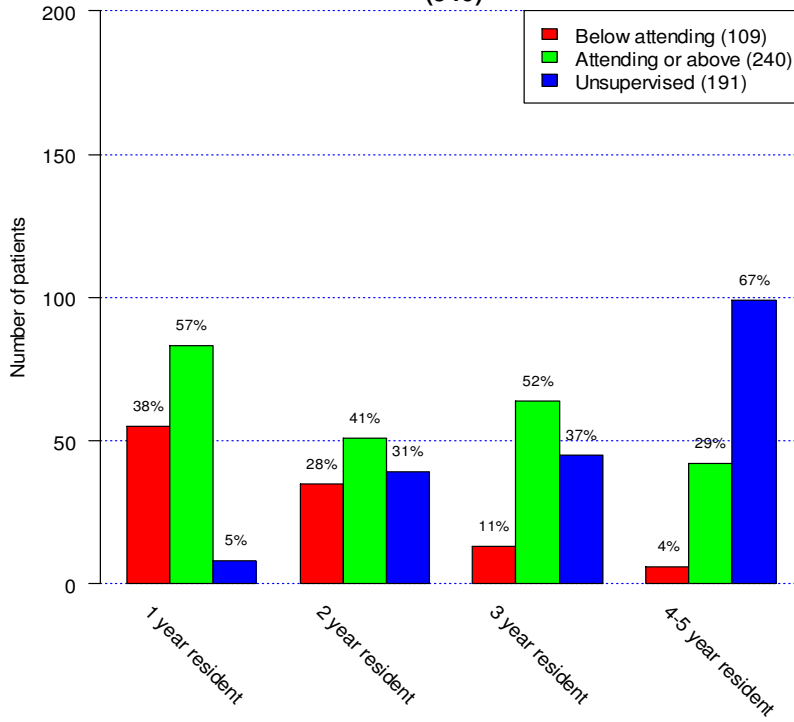
**Surgical delay for proximal antebrachium fractures
(832)**
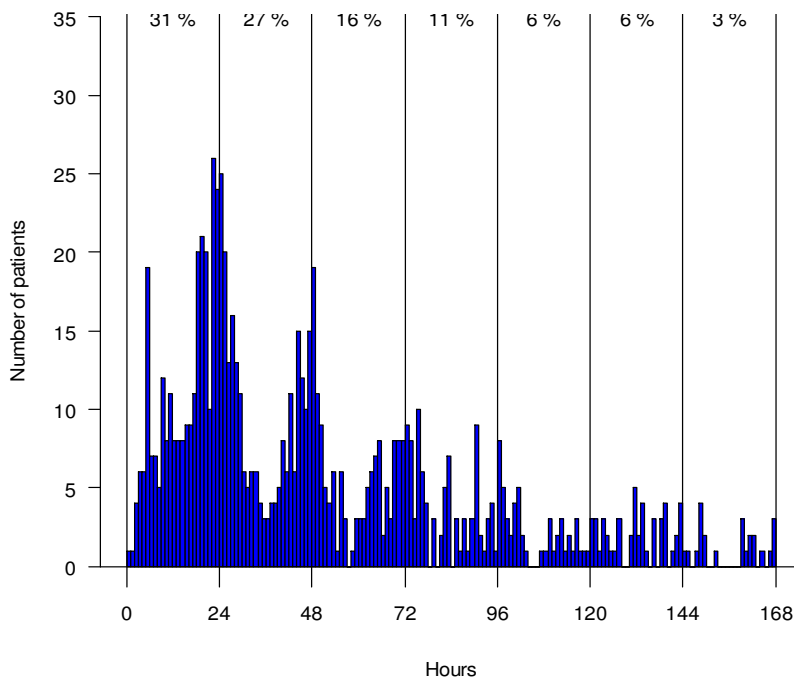
(Proportion of patients operated in 24 hour intervals)

**Survival for primary procedure with reoperation due to any reason
proximal antebrachium fractures
(950)**
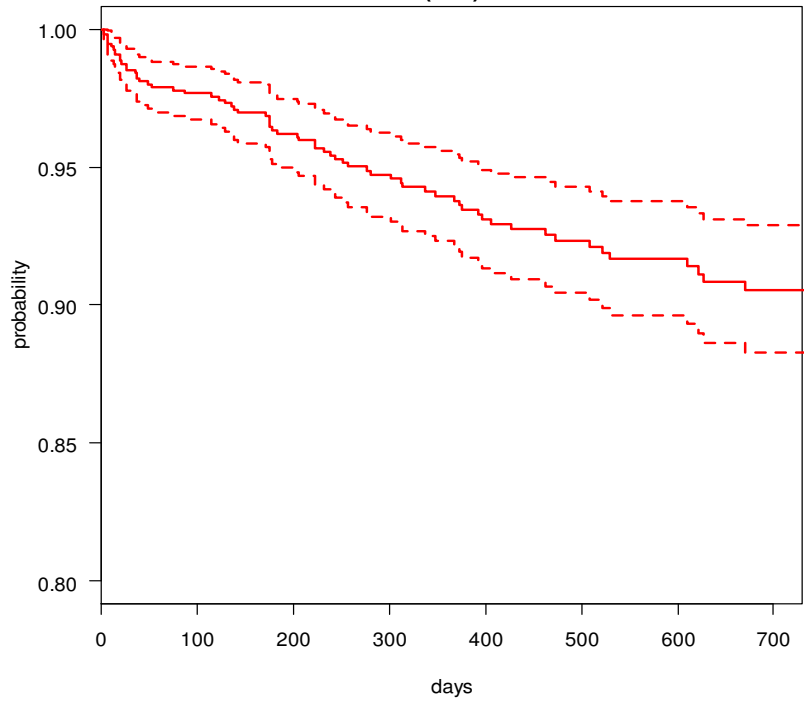
**Survival for primary procedure with reoperation due to any reason
except pain and discomfort from surgical hardware
proximal antebrachium fractures
(950)**
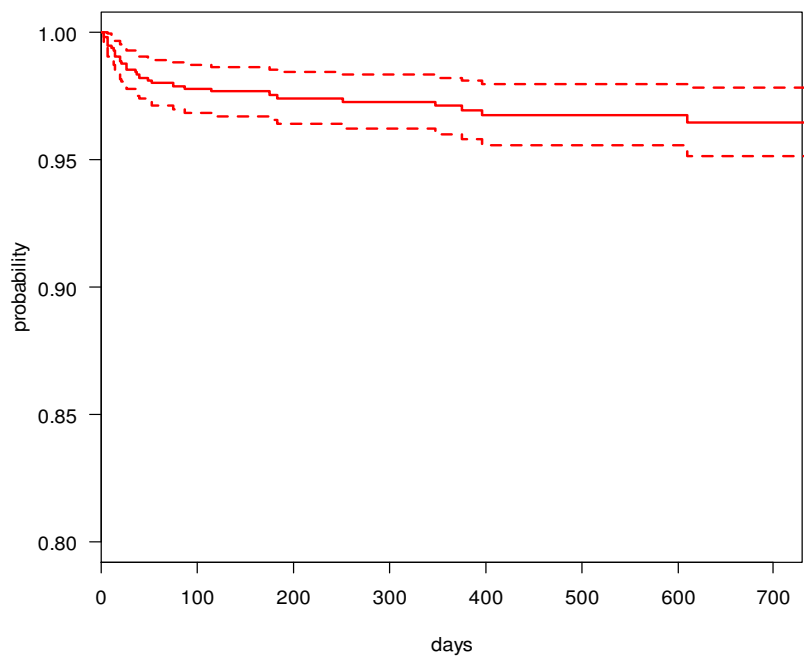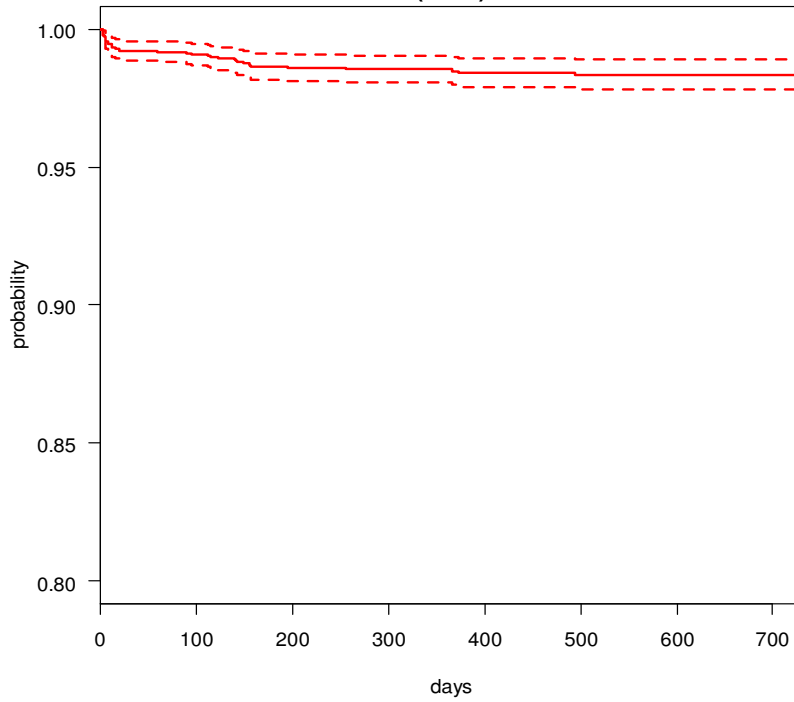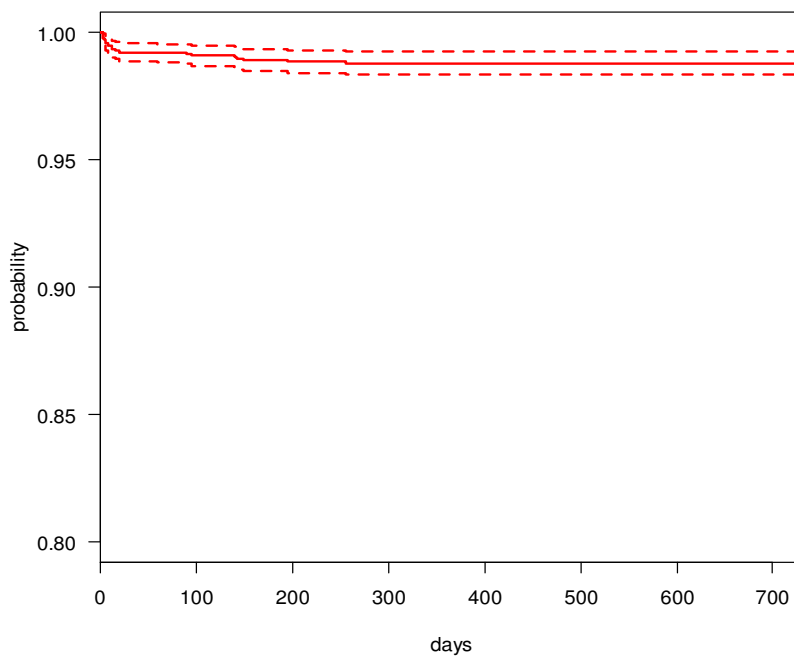
Fracture classification for proximal antebrachium fractures (950)

Antebrachium

Method of osteosynthesis antebrachium fractures (386)

Indication for reoperations of antebrachium fractures (43)

**Surgeon level for antebrachium fractures
(401)**

Number of patients

| Intern | 1 year resident | 2 year resident | 3 year resident | 4-5 year resident | Attending | Traumatologist |
| 0% | 11% | 12% | 15% | 20% | 36% | 6% |

**Level of supervision for antebrachium fractures
(393)**

Number of patients

| 1 year resident | 2 year resident | 3 year resident | 4-5 year resident | Attending | Traumatologist | Unsupervised |
| 0% | 1% | 3% | 7% | 28% | 5% | 56% |
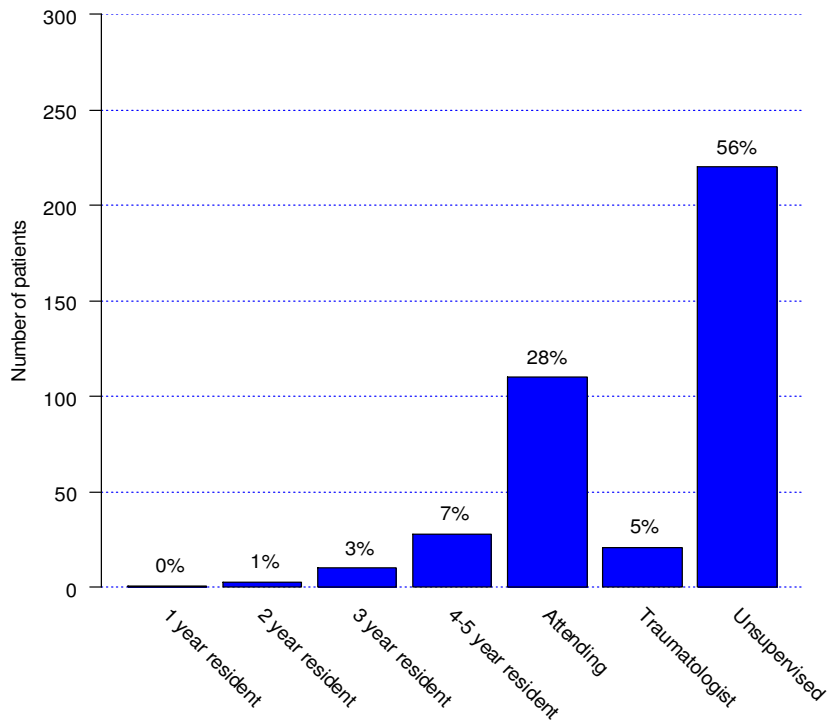
Level of supervision for interns and residents
antebrachium fractures
(233)
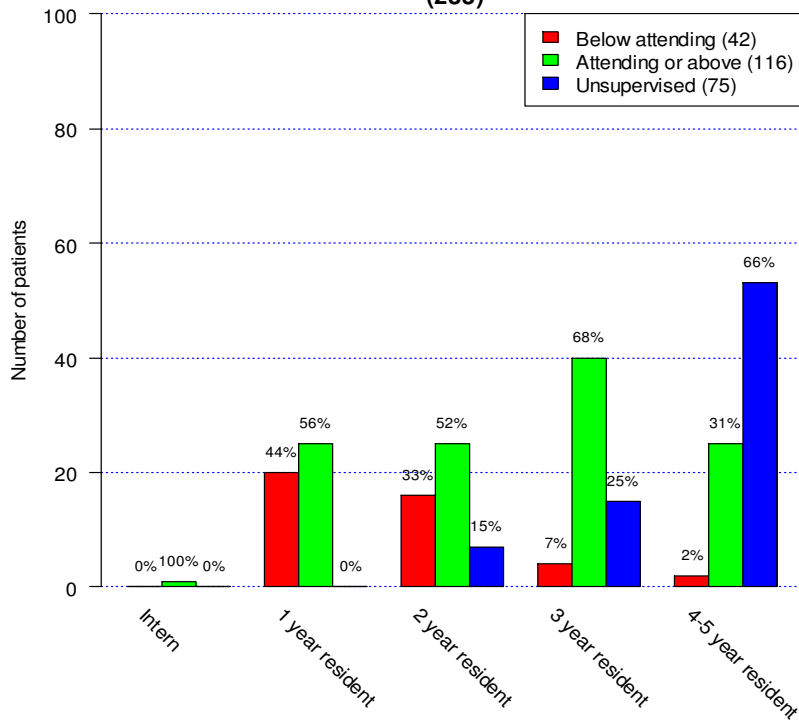
Surgical delay for antebrachium fractures
(350)
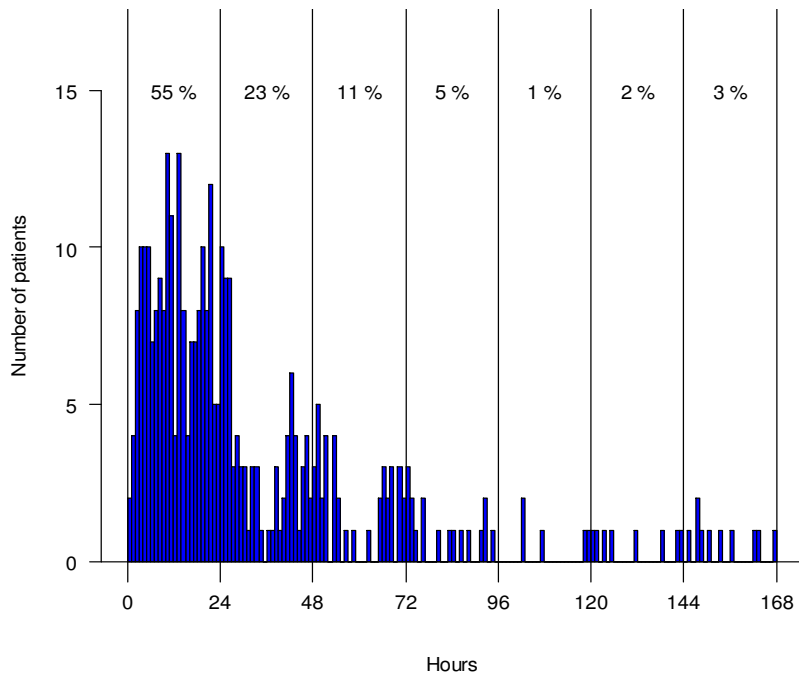
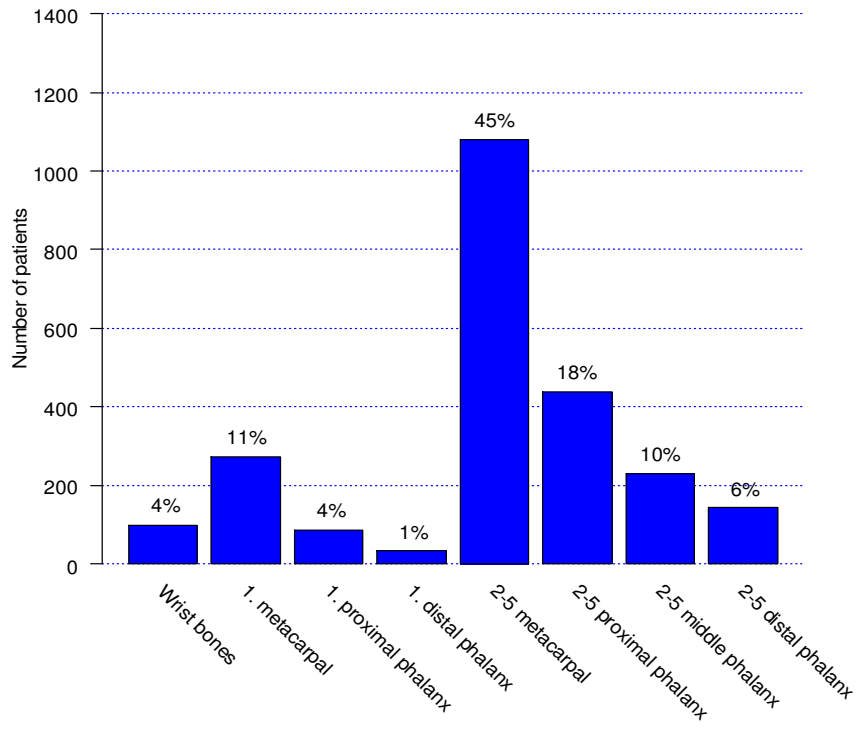(Proportion of patients operated in 24 hour intervals)

**Survival for primary procedure with reoperation due to any reason
antebrachium fractures
(401)**

**Survival for primary procedure with reoperation due to any reason
except pain and discomfort from surgical hardware
antebrachium fractures
(401)**

Fracture classification for antebrachium fractures (401)

Distal radius

**Method of osteosynthesis distal radius fractures
(4284)**
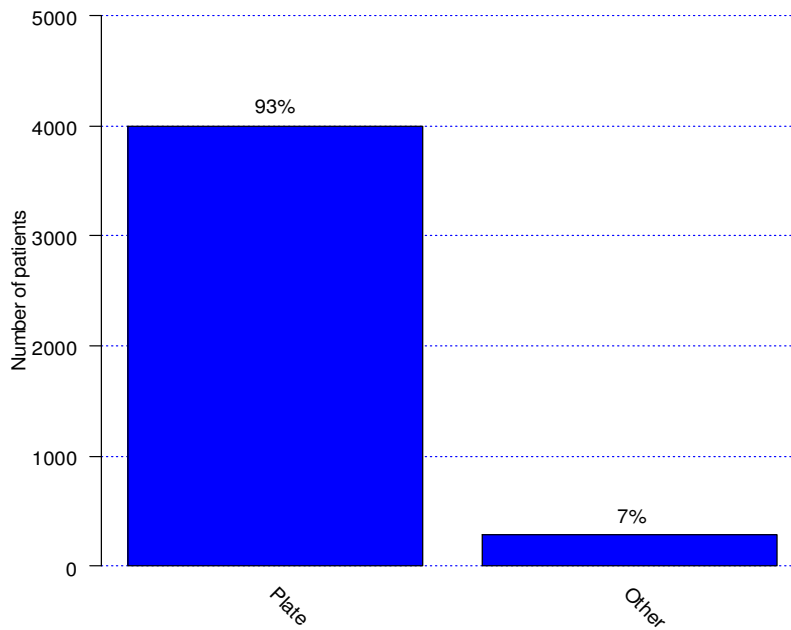
**Indication for reoperations of distal radius fractures
(233)**
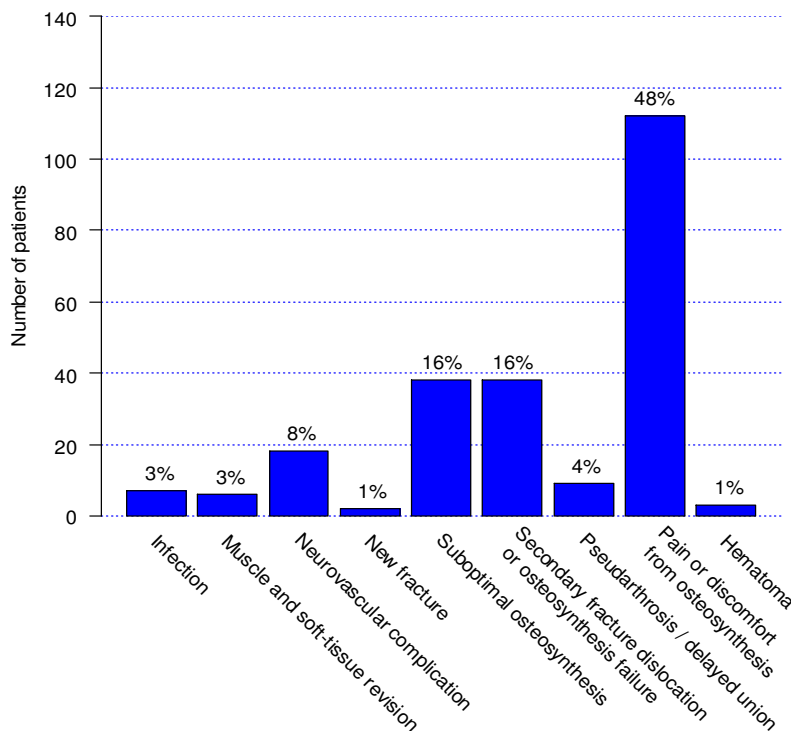
**Surgeon level for distal radius fractures
(4366)**
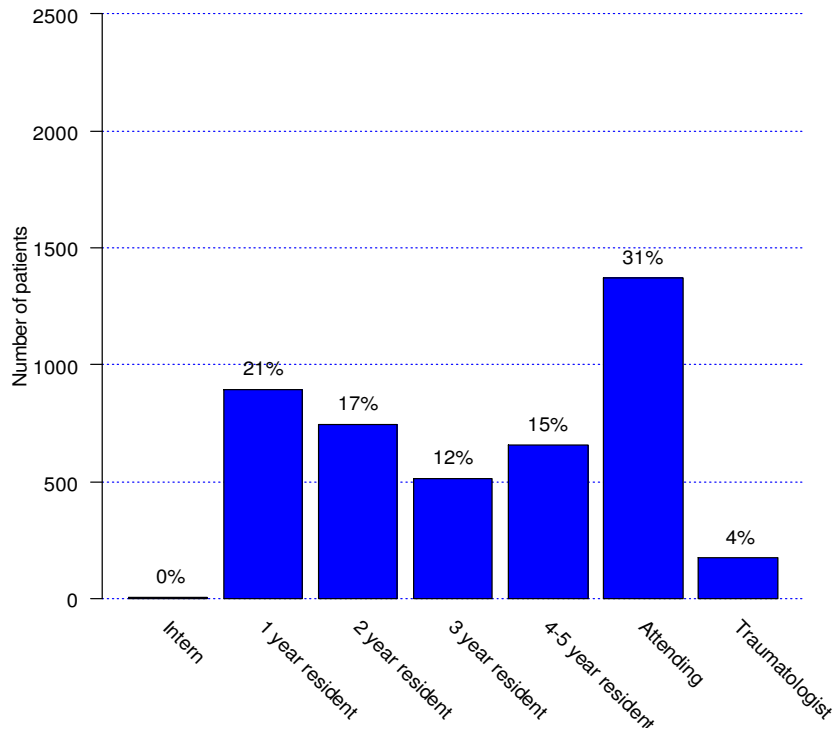
**Level of supervision for distal radius fractures
(4265)**
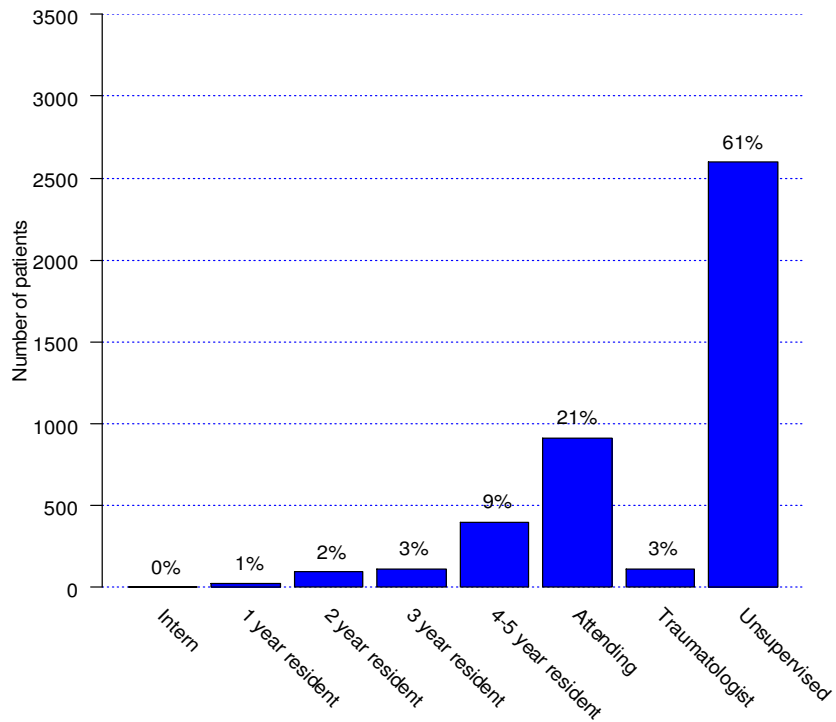
**Level of supervision for interns and residents
distal radius fractures
(2804)**

Legend:
- Below attending (632) — red
- Attending or above (963) — green
- Unsupervised (1209) — blue

Y-axis: Number of patients

Categories: Intern, 1 year resident, 2 year resident, 3 year resident, 4-5 year resident

Percentages:
- Intern: 67%, 33%, 0%
- 1 year resident: 45%, 41%, 13%
- 2 year resident: 20%, 37%, 43%
- 3 year resident: 10%, 44%, 47%
- 4-5 year resident: 3%, 14%, 82%

**Surgical delay for distal radius fractures
(3800)**
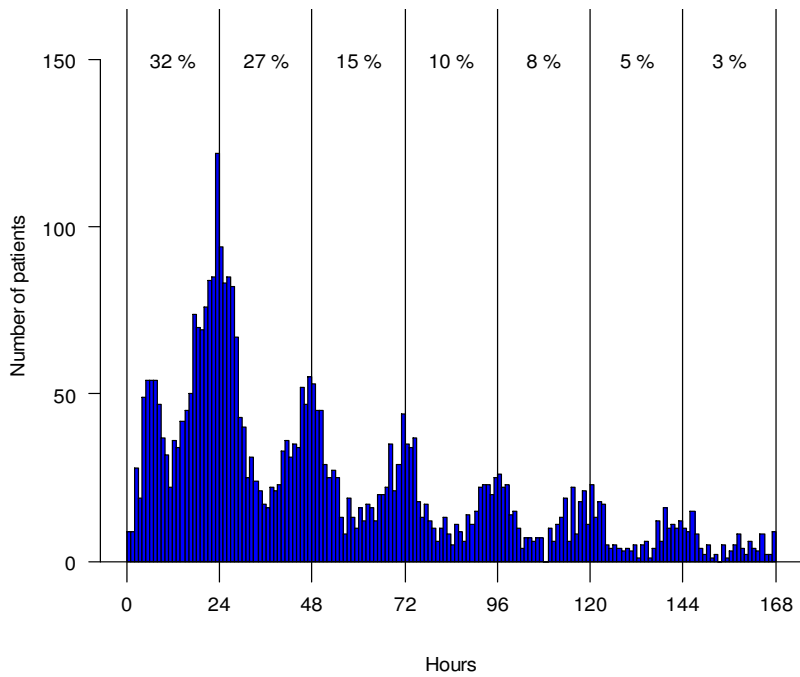
Y-axis: Number of patients
X-axis: Hours (0, 24, 48, 72, 96, 120, 144, 168)

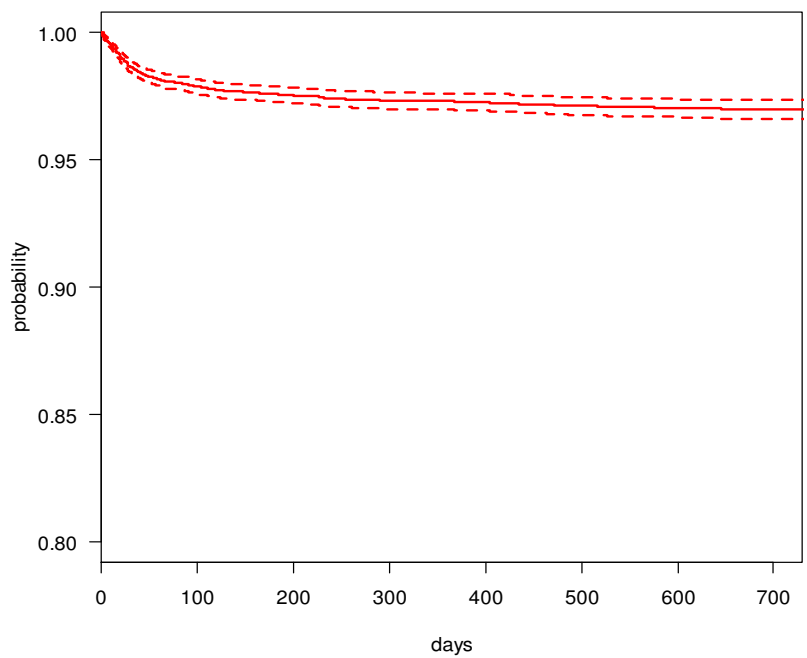Percentages: 32 %, 27 %, 15 %, 10 %, 8 %, 5 %, 3 %

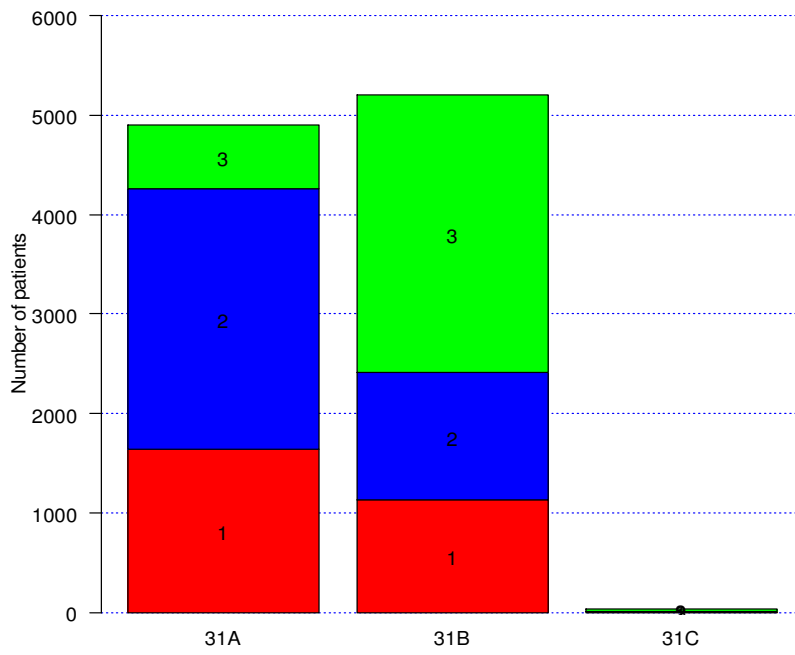(Proportion of patients operated in 24 hour intervals)

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Survival for primary procedure with reoperation due to any reason
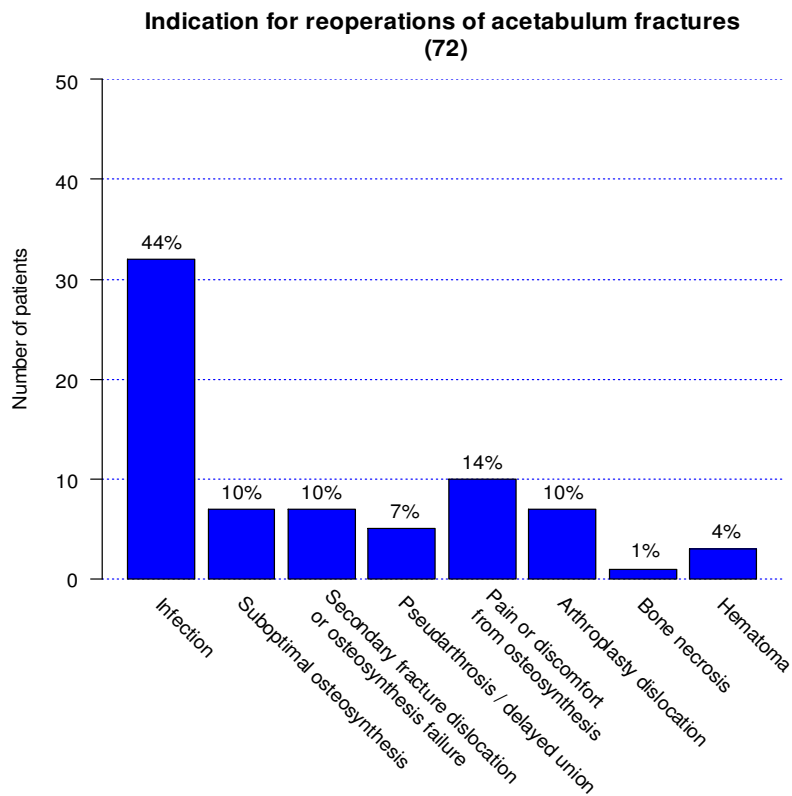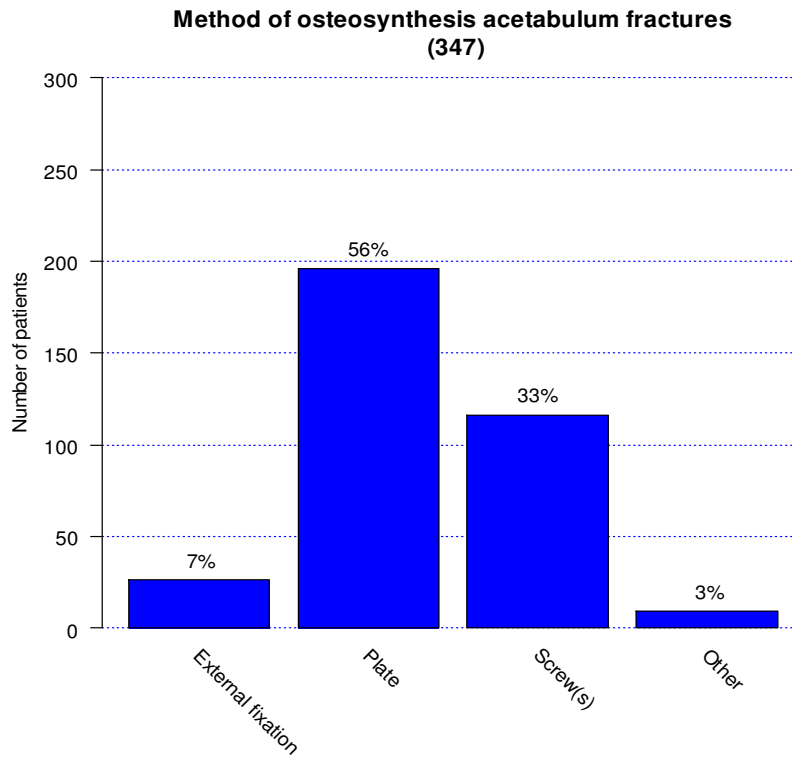## distal radius fractures
(4376)

Survival for primary procedure with reoperation due to any reason
## except pain and discomfort from surgical hardware
distal radius fractures
(4376)

**Fracture classification for distal radius fractures
(4375)**

Hand

Method of osteosynthesis hand fractures
(2352)

## Indication for reoperations of hand fractures
(80)

Surgeon level for hand fractures
(2381)
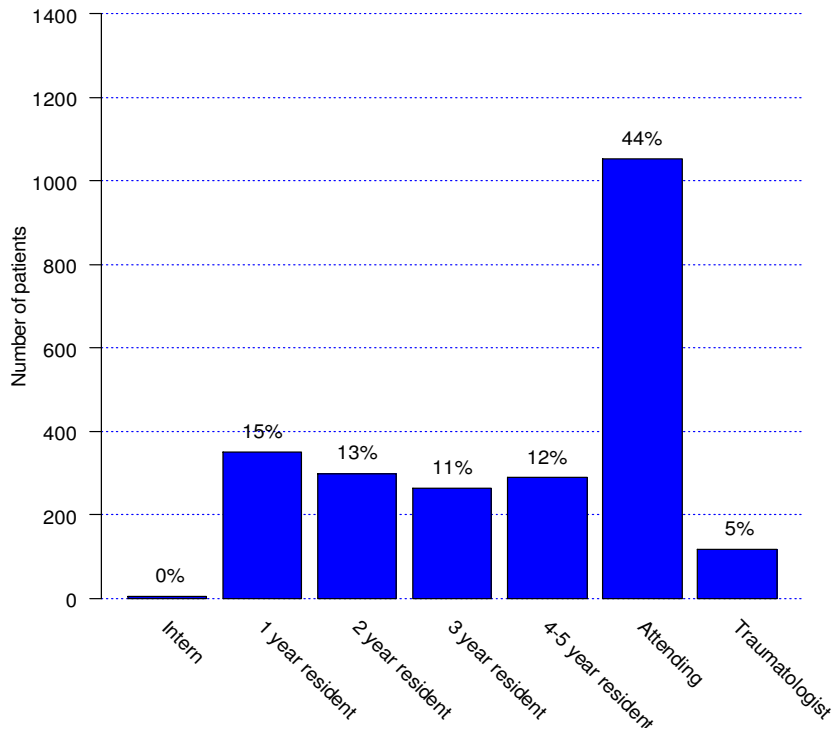
Level of supervision for hand fractures
(2328)
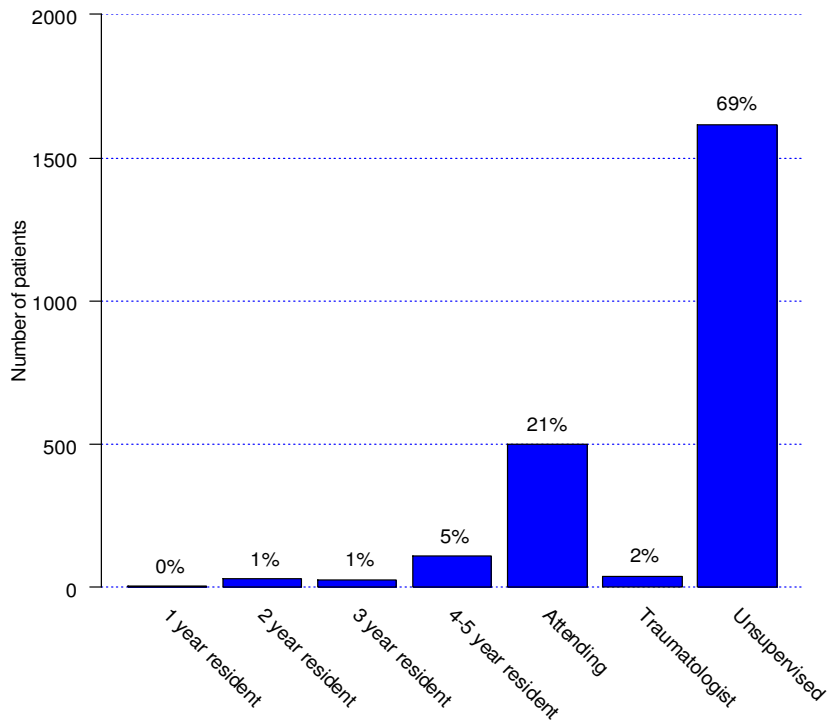
Level of supervision for interns and residents hand fractures
(1199)
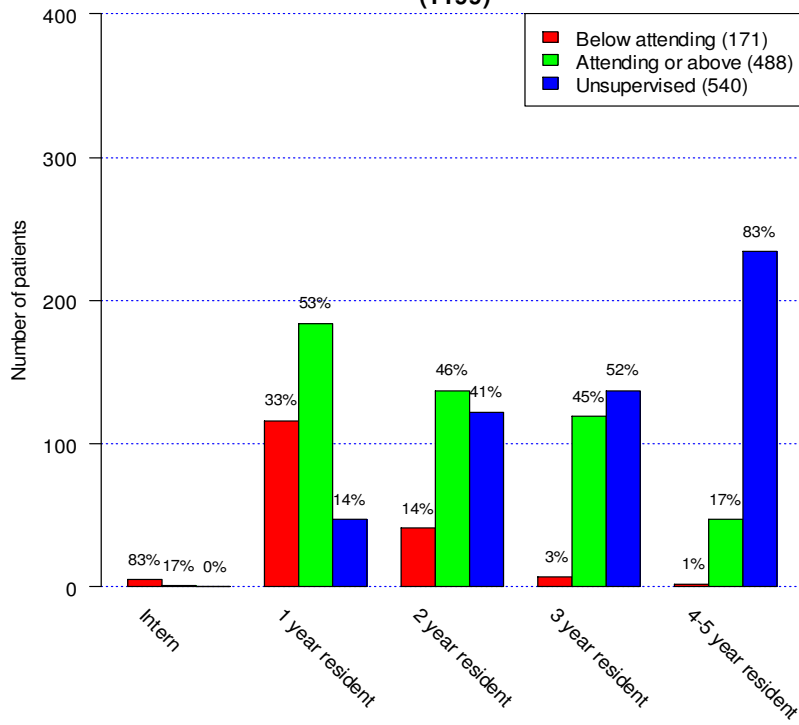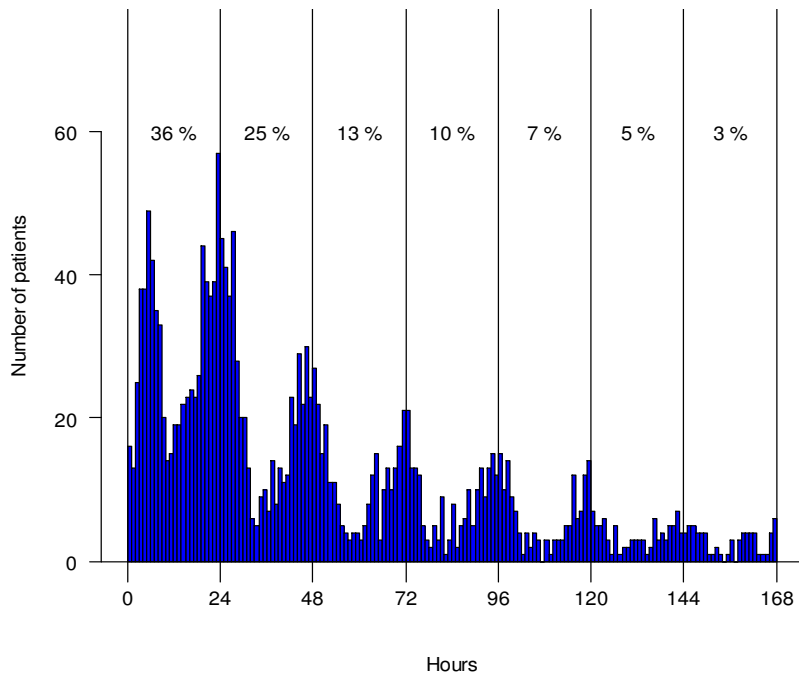
Legend:
- Below attending (171) — red
- Attending or above (488) — green
- Unsupervised (540) — blue

Number of patients

Intern: 83% 17% 0%
1 year resident: 33% 53% 14%
2 year resident: 14% 46% 41%
3 year resident: 3% 45% 52%
4-5 year resident: 1% 17% 83%

Surgical delay for hand fractures
(1964)

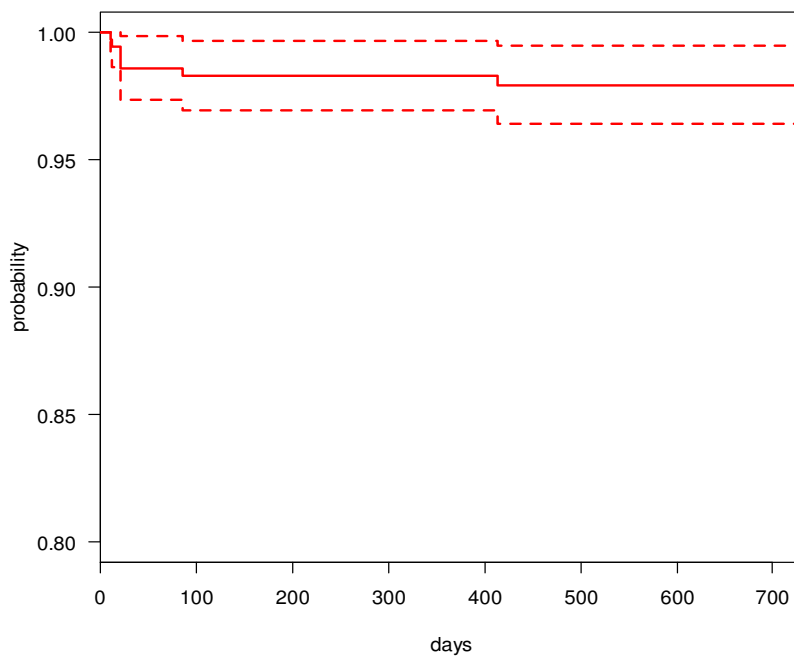Number of patients

36 %   25 %   13 %   10 %   7 %   5 %   3 %

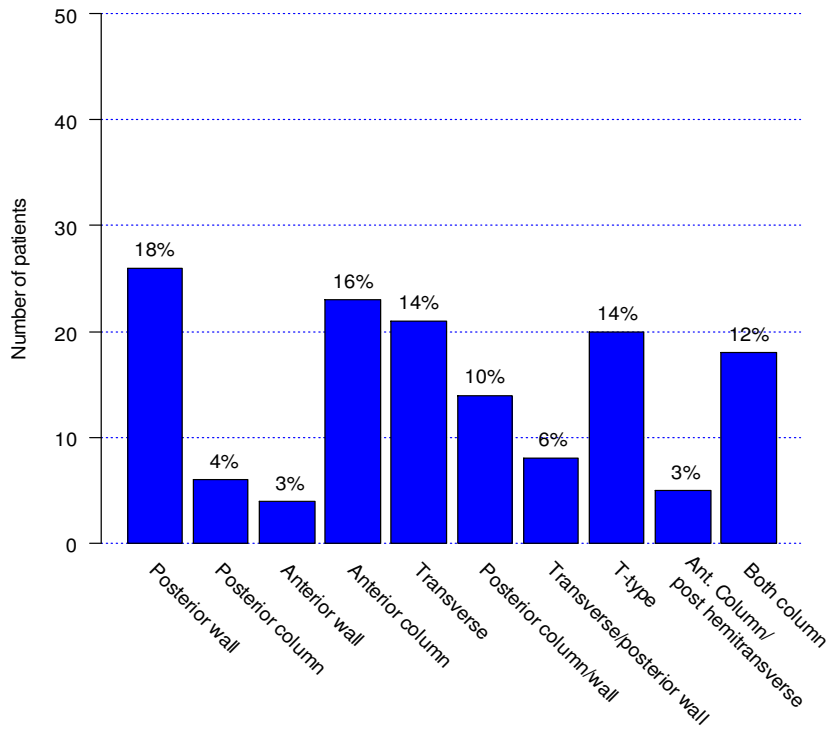Hours

(Proportion of patients operated in 24 hour intervals)

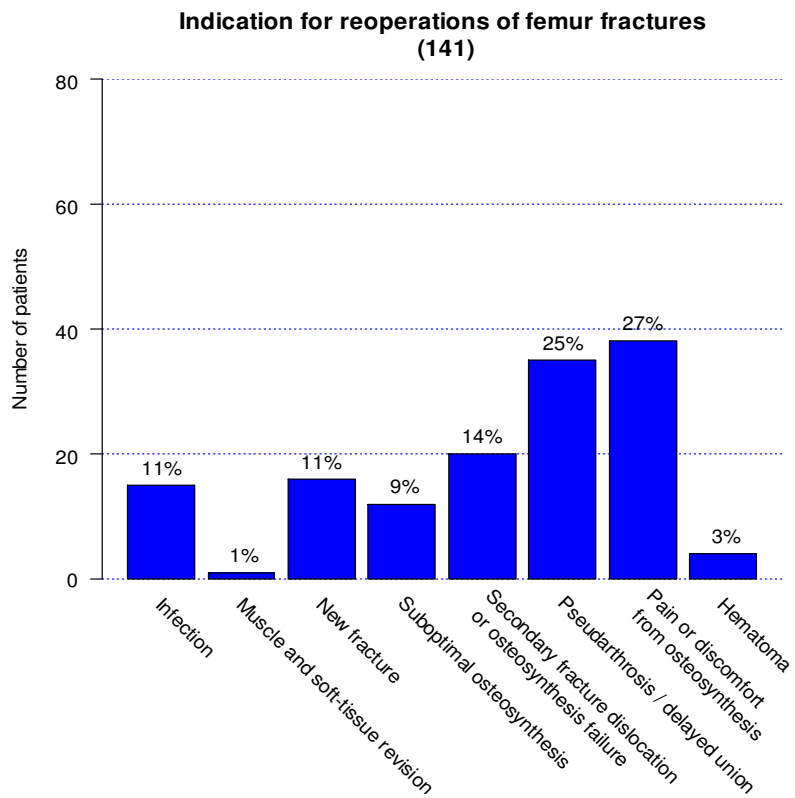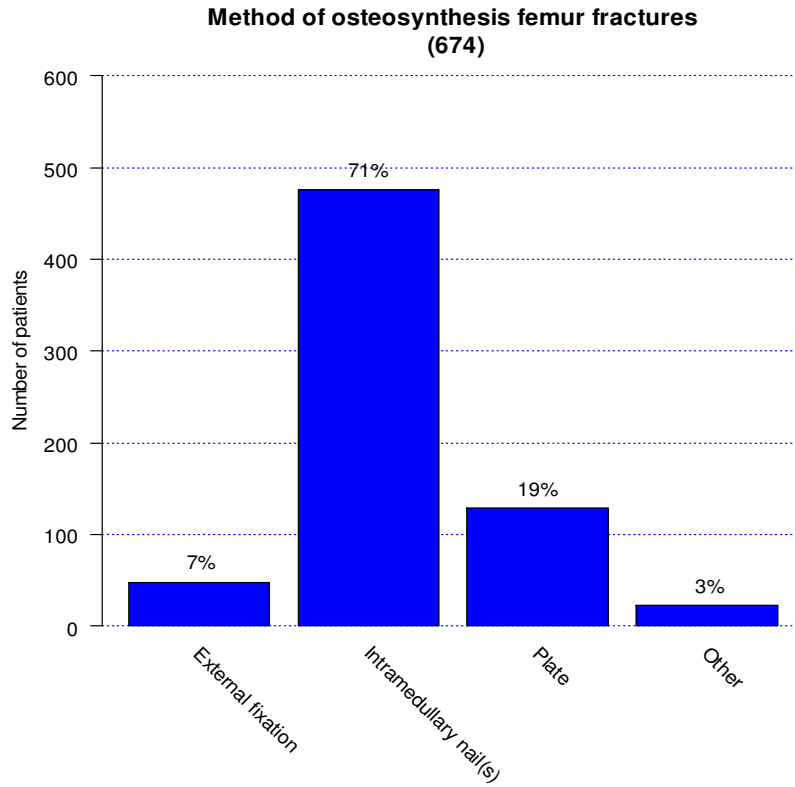**Survival for primary procedure with reoperation due to any reason
hand fractures
(2380)**

**Survival for primary procedure with reoperation due to any reason
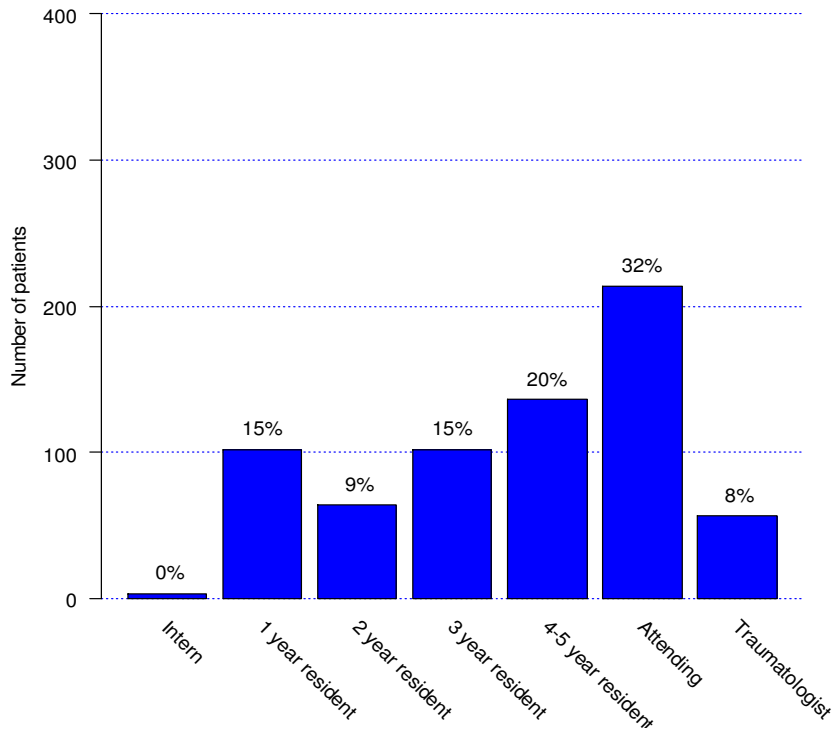except pain and discomfort from surgical hardware
hand fractures
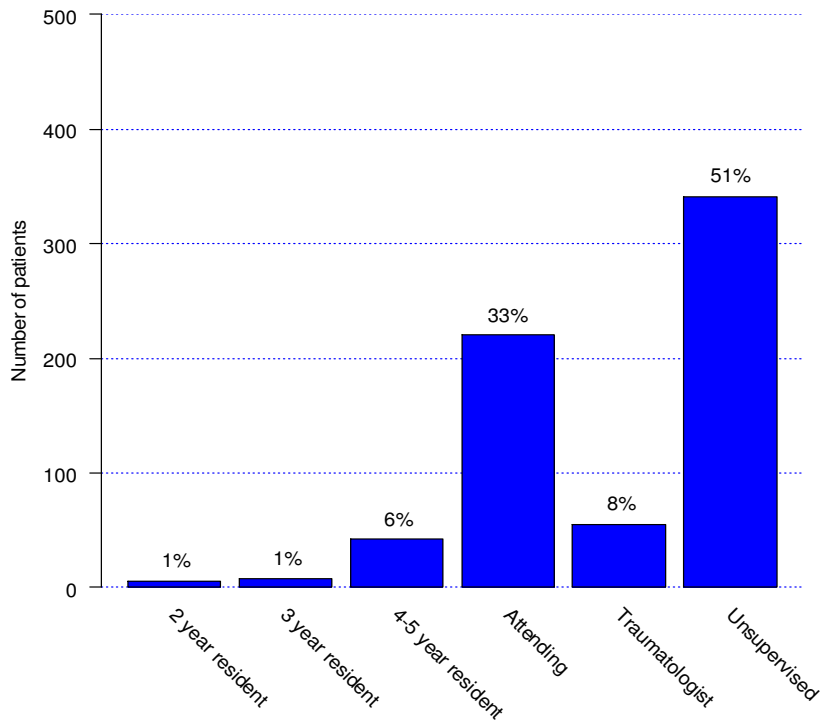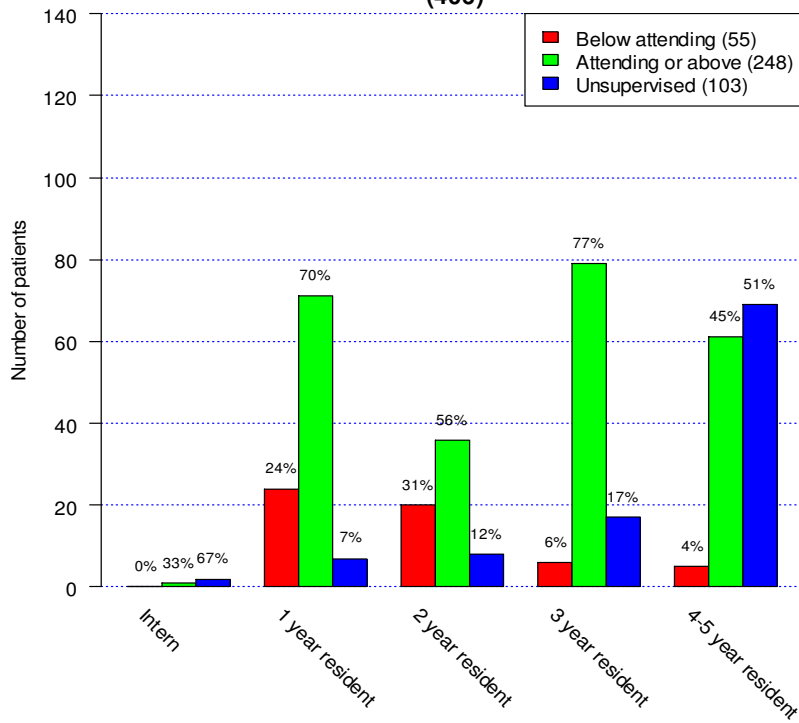(2380)**

Fracture classification for hand fractures
(2381)

Proximal femur

Method of osteosynthesis proximal femur fractures (10127)
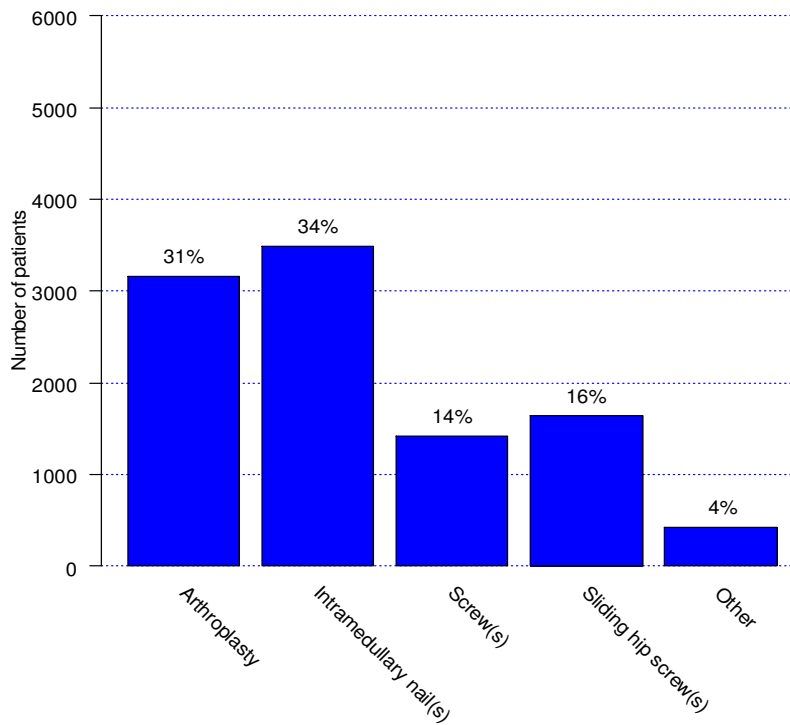
Indication for reoperations of proximal femur fractures (953)
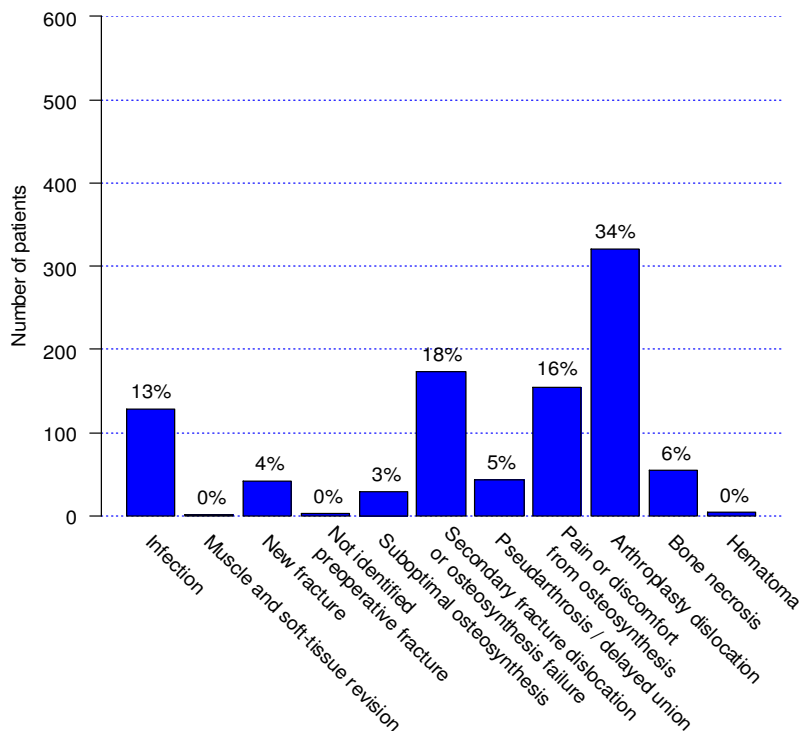
Surgeon level for proximal femur fractures (10110)
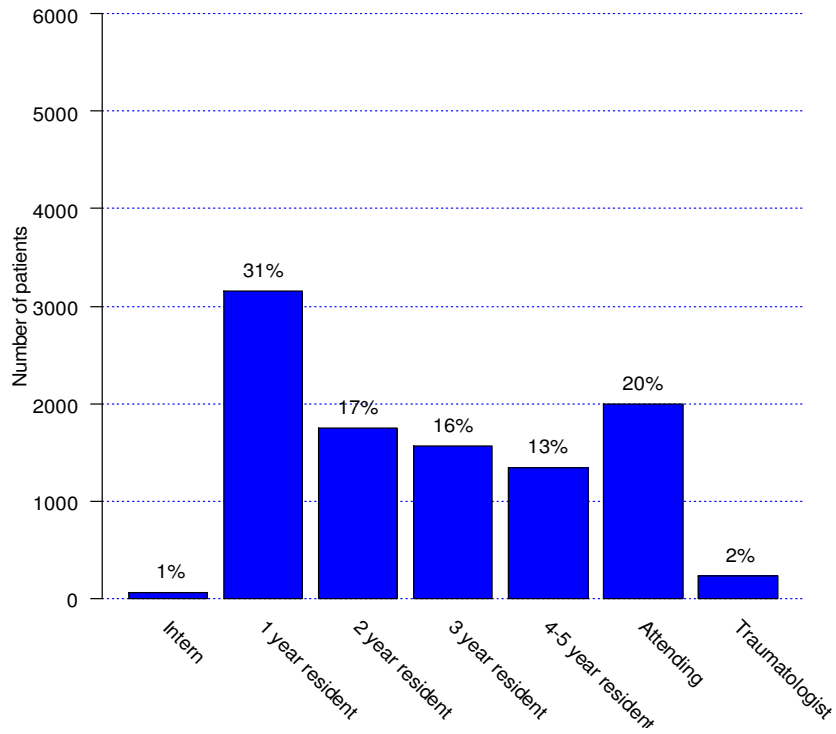
Level of supervision for proximal femur fractures (9860)
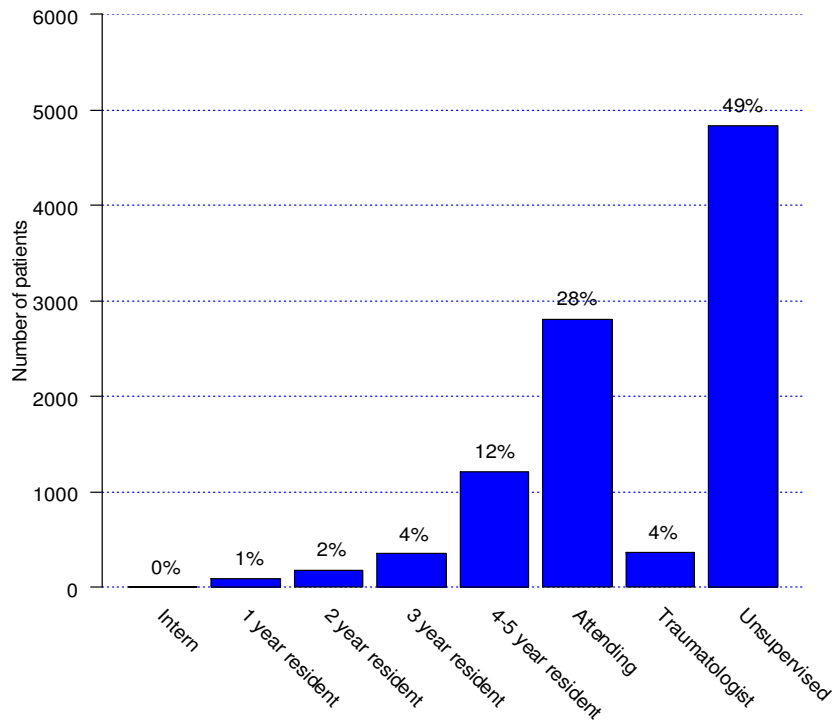
Level of supervision for interns and residents
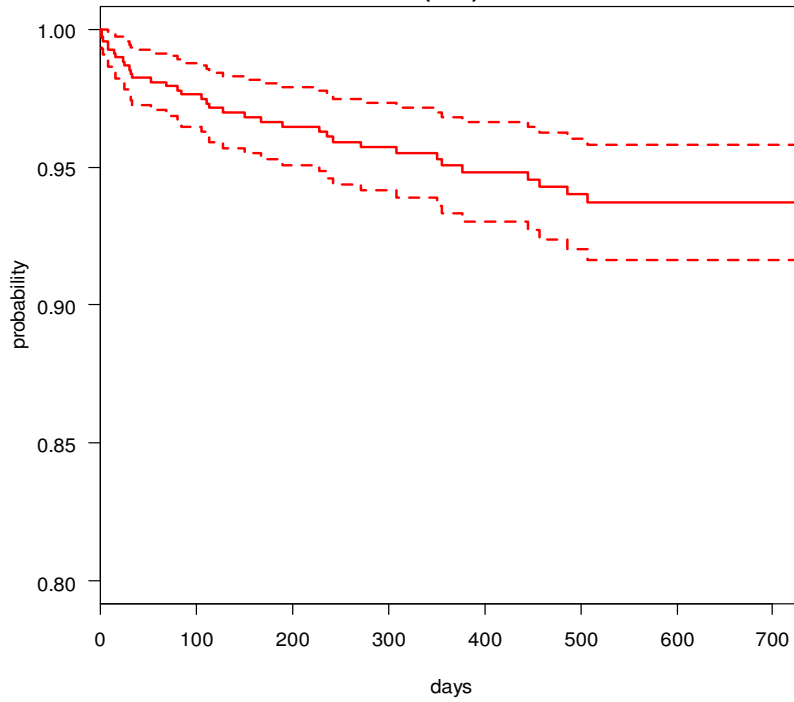## proximal femur fractures
(7827)
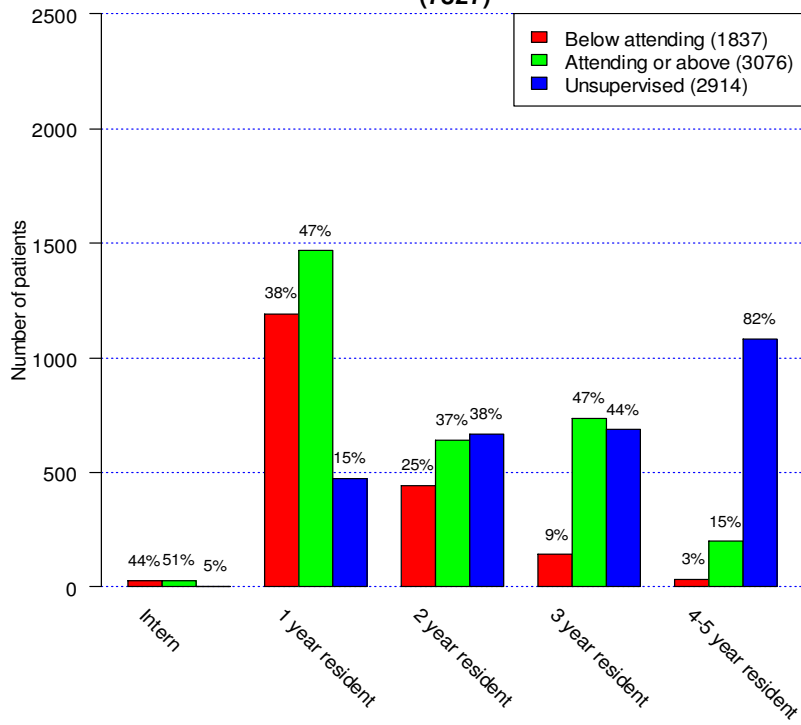
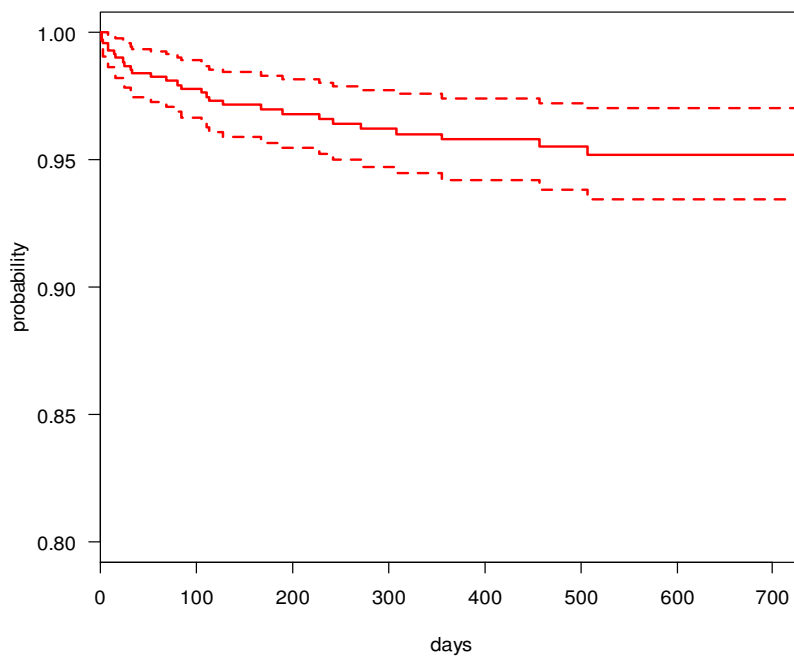## Surgical delay for proximal femur fractures
(9631)
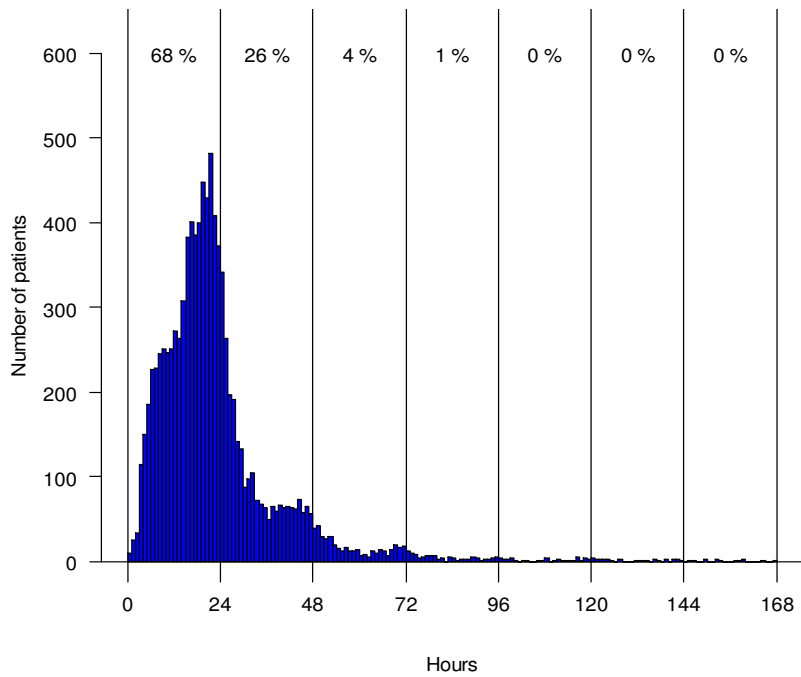
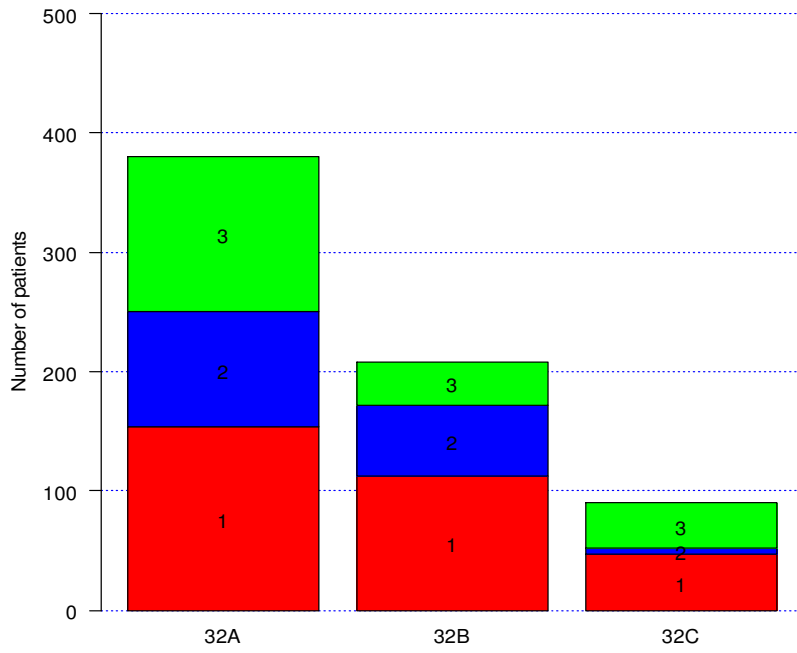(Proportion of patients operated in 24 hour intervals)

**Survival for primary procedure with reoperation due to any reason
proximal femur fractures
(10132)**
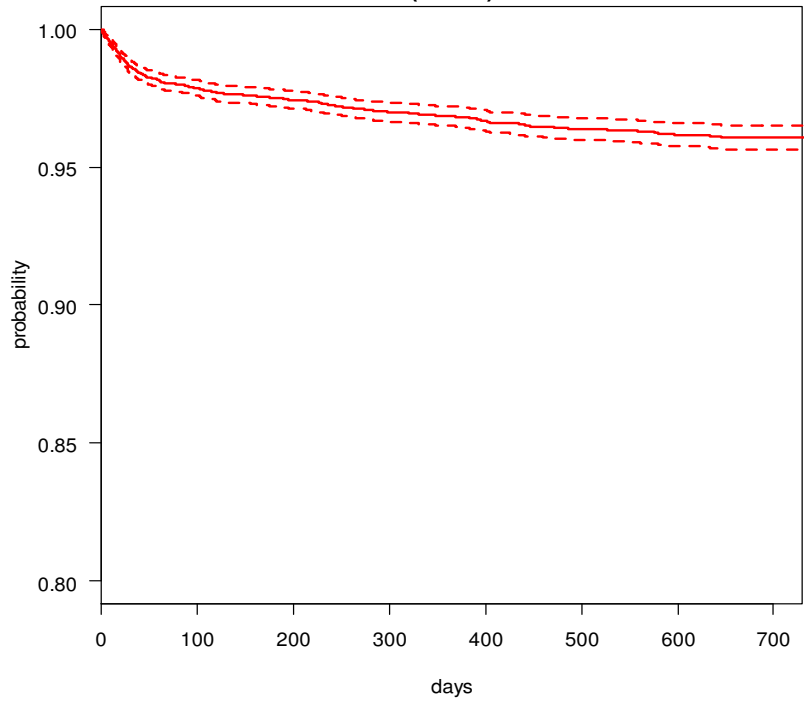
**Survival for primary procedure with reoperation due to any reason
except pain and discomfort from surgical hardware
proximal femur fractures
(10132)**

Fracture classification for proximal femur fractures (10133)

Acetabulum

**Method of osteosynthesis acetabulum fractures
(347)**

**Indication for reoperations of acetabulum fractures
(72)**

Surgeon level for acetabulum fractures
(348)
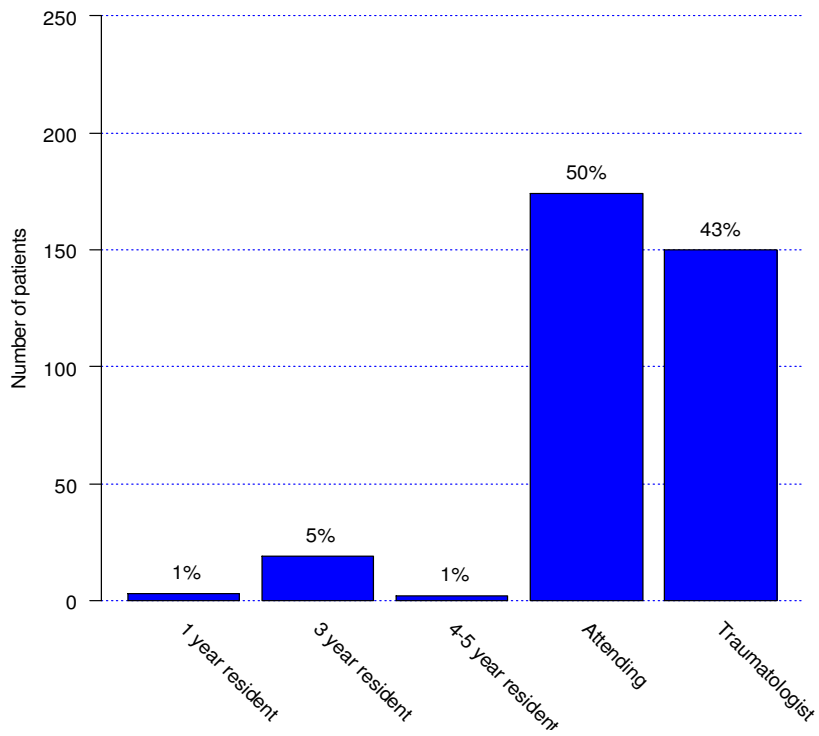
Level of supervision for acetabulum fractures
(348)
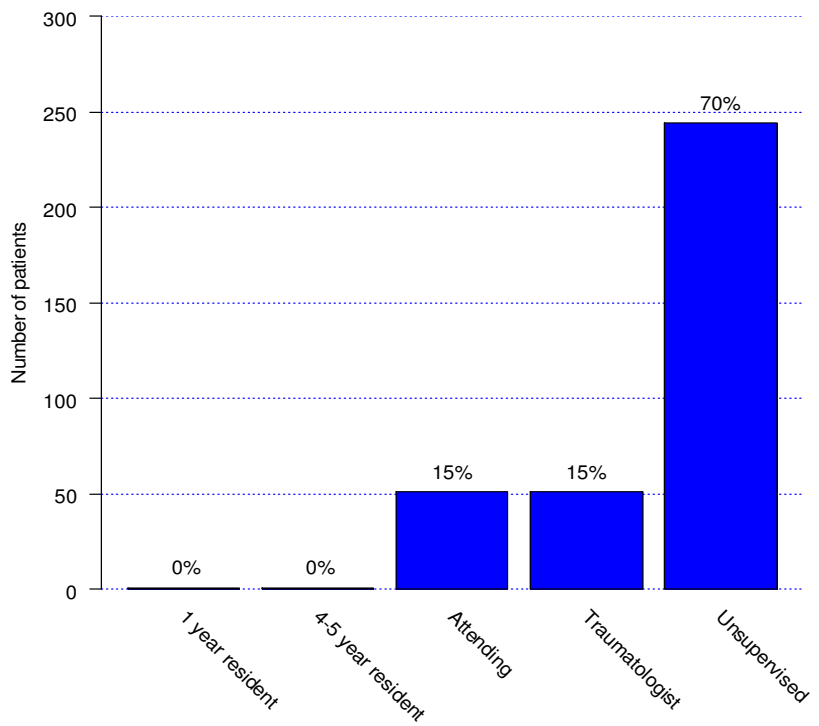
Level of supervision for interns and residents acetabulum fractures
(24)
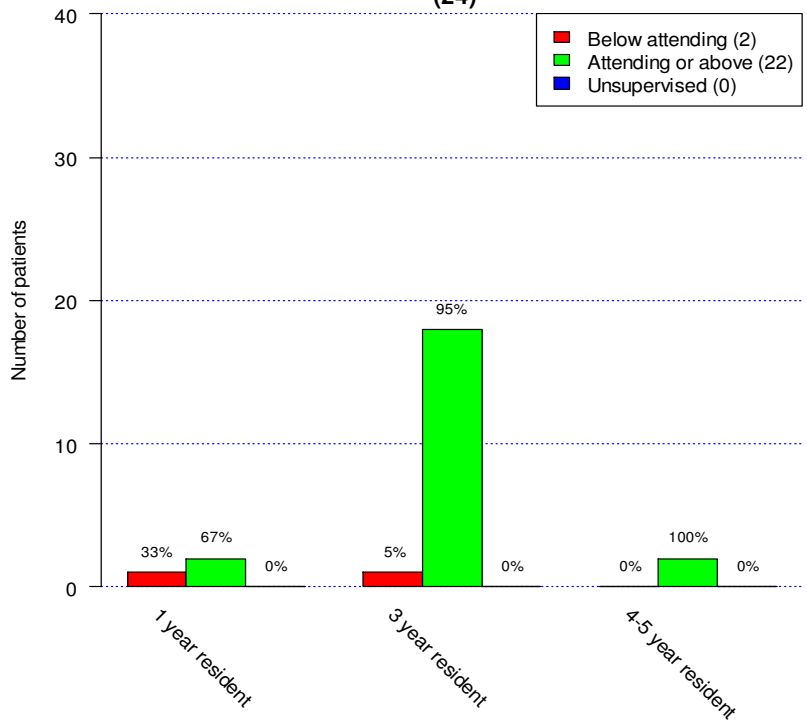
Surgical delay for acetabulum fractures
(286)
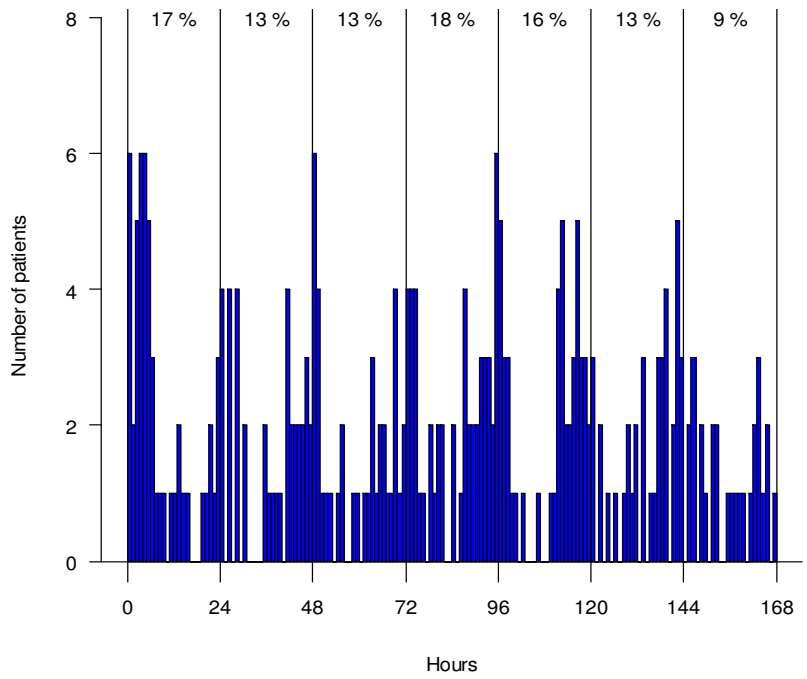
(Proportion of patients operated in 24 hour intervals)

Survival for primary procedure with reoperation due to any reason
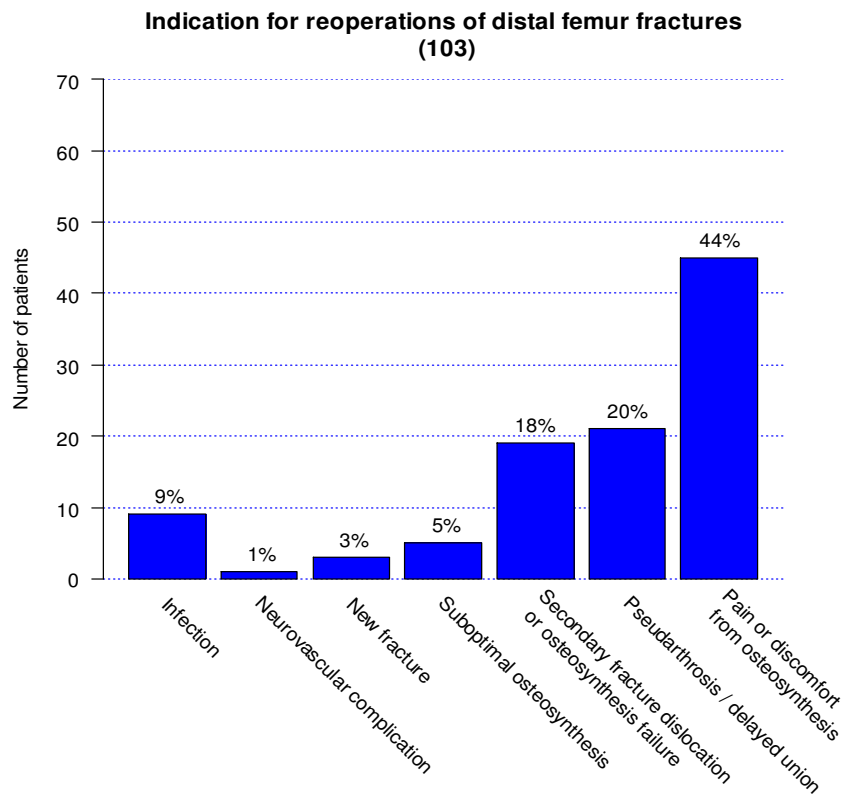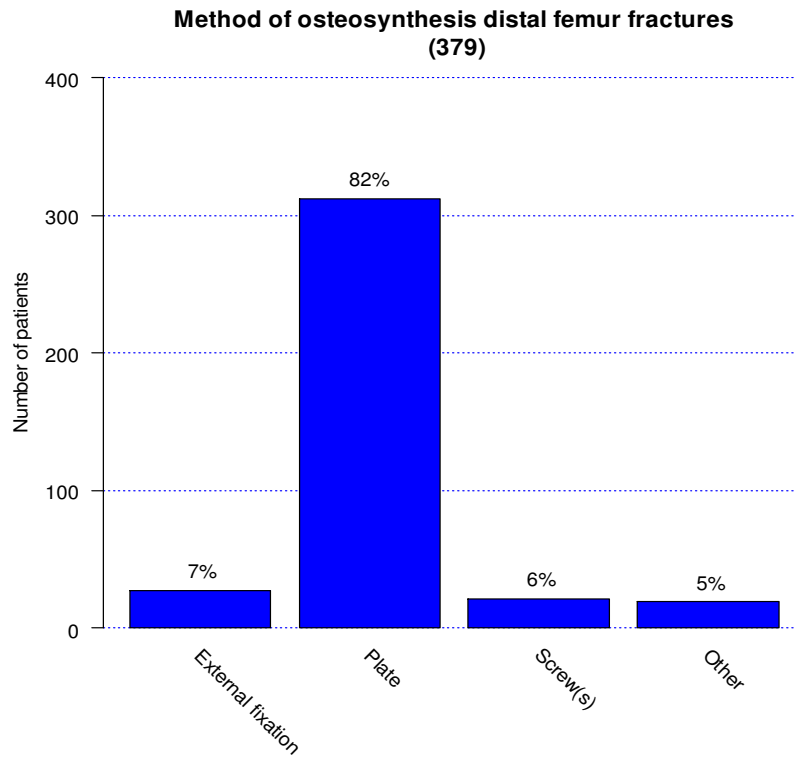**acetabulum fractures**
(348)
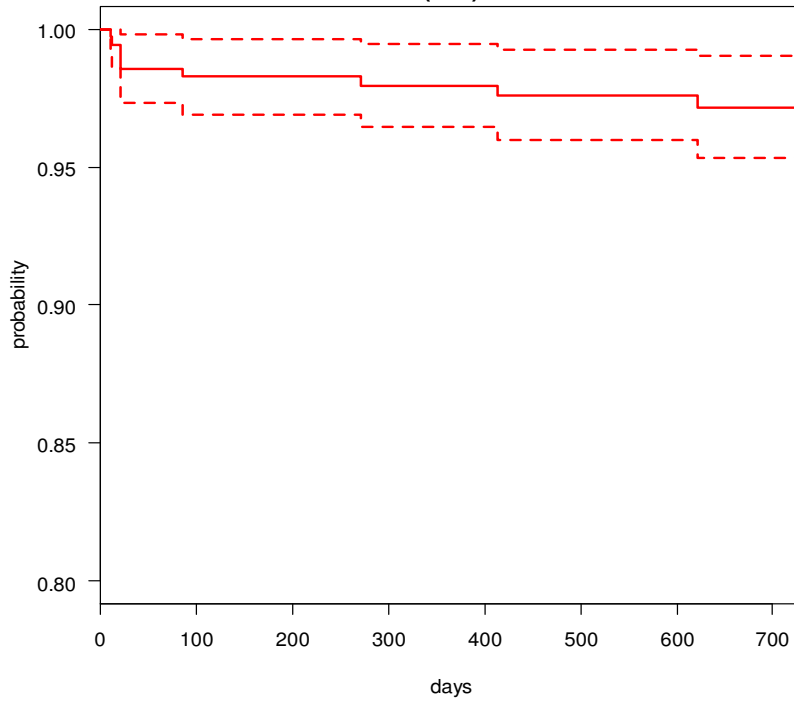
Survival for primary procedure with reoperation due to any reason
except pain and discomfort from surgical hardware
**acetabulum fractures**
(348)

**Fracture classification for acetabulum fractures
(145)**

Femur

**Method of osteosynthesis femur fractures
(674)**

Number of patients

- External fixation — 7%
- Intramedullary nail(s) — 71%
- Plate — 19%
- Other — 3%

**Indication for reoperations of femur fractures
(141)**

Number of patients

- Infection — 11%
- Muscle and soft-tissue revision — 1%
- New fracture — 11%
- Suboptimal osteosynthesis — 9%
- Secondary fracture dislocation or osteosynthesis failure — 14%
- Pseudarthrosis / delayed union — 25%
- Pain or discomfort from osteosynthesis — 27%
- Hematoma — 3%

Surgeon level for femur fractures
(678)

Level of supervision for femur fractures
(672)

Level of supervision for interns and residents
femur fractures
(406)
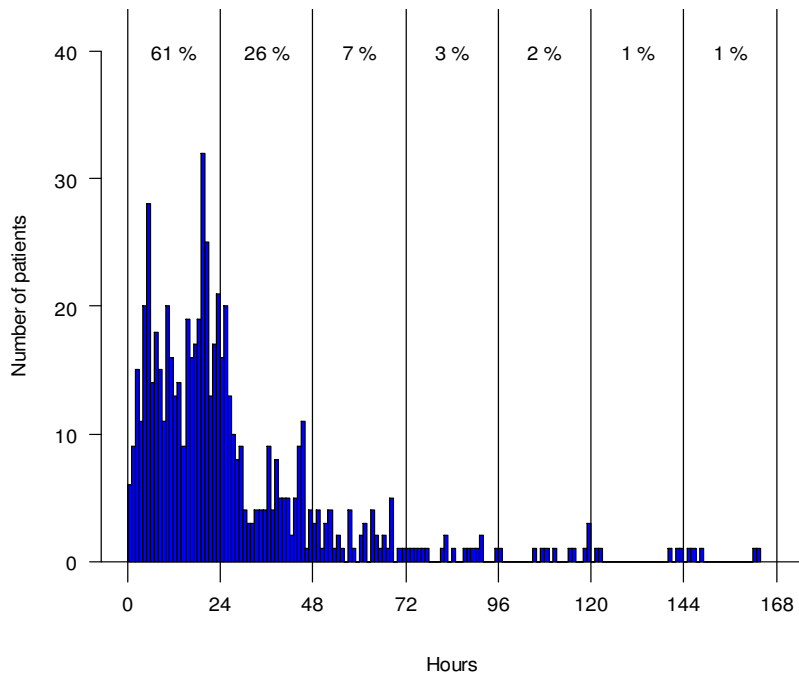
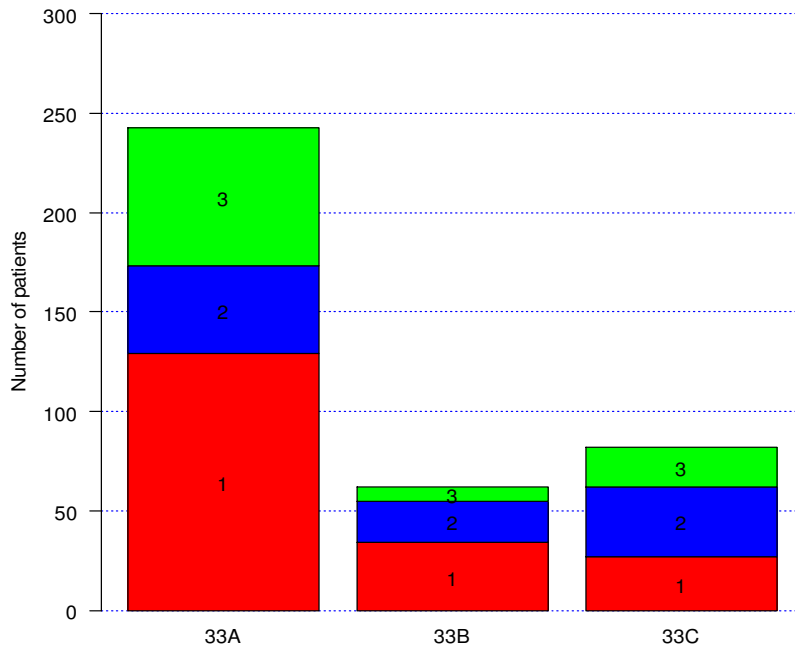
Legend:
- Below attending (55) [red]
- Attending or above (248) [green]
- Unsupervised (103) [blue]

Y-axis: Number of patients

Categories (X-axis): Intern, 1 year resident, 2 year resident, 3 year resident, 4-5 year resident

Intern: 0%, 33%, 67%
1 year resident: 24%, 70%, 7%
2 year resident: 31%, 56%, 12%
3 year resident: 6%, 77%, 17%
4-5 year resident: 4%, 45%, 51%

Surgical delay for femur fractures
(648)

61 %   26 %   7 %   3 %   2 %   1 %   1 %

Y-axis: Number of patients

X-axis: Hours (0, 24, 48, 72, 96, 120, 144, 168)

(Proportion of patients operated in 24 hour intervals)

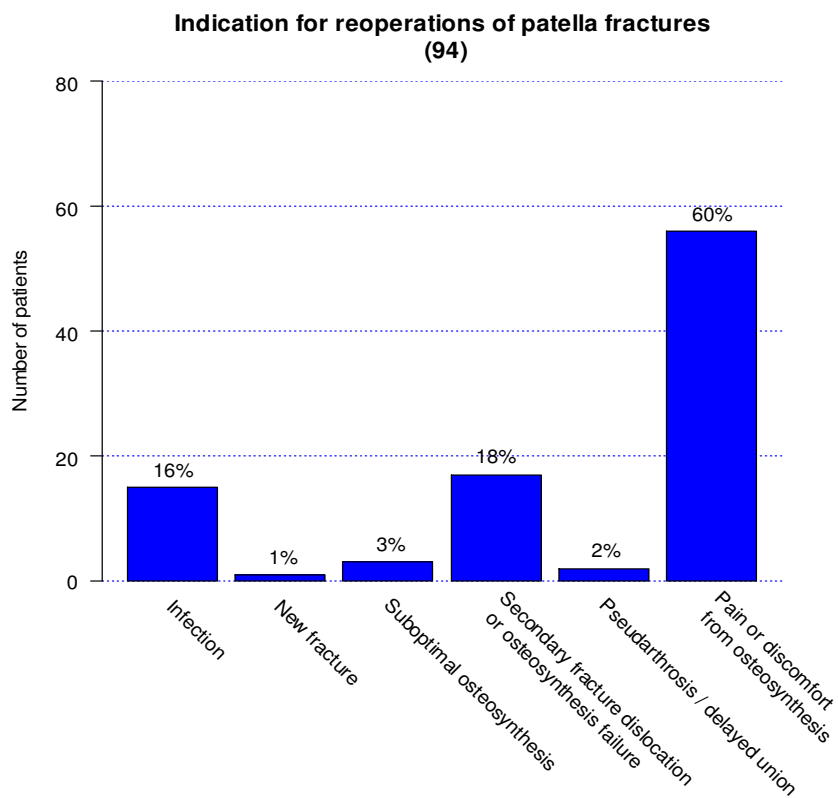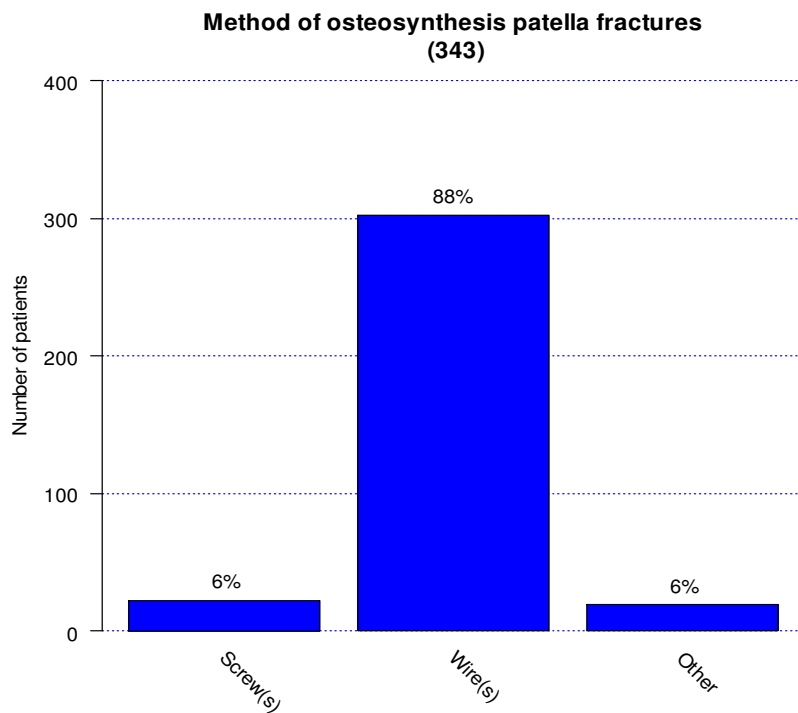**Survival for primary procedure with reoperation due to any reason**
femur fractures
(678)

Survival for primary procedure with reoperation due to any reason
**except pain and discomfort from surgical hardware**
femur fractures
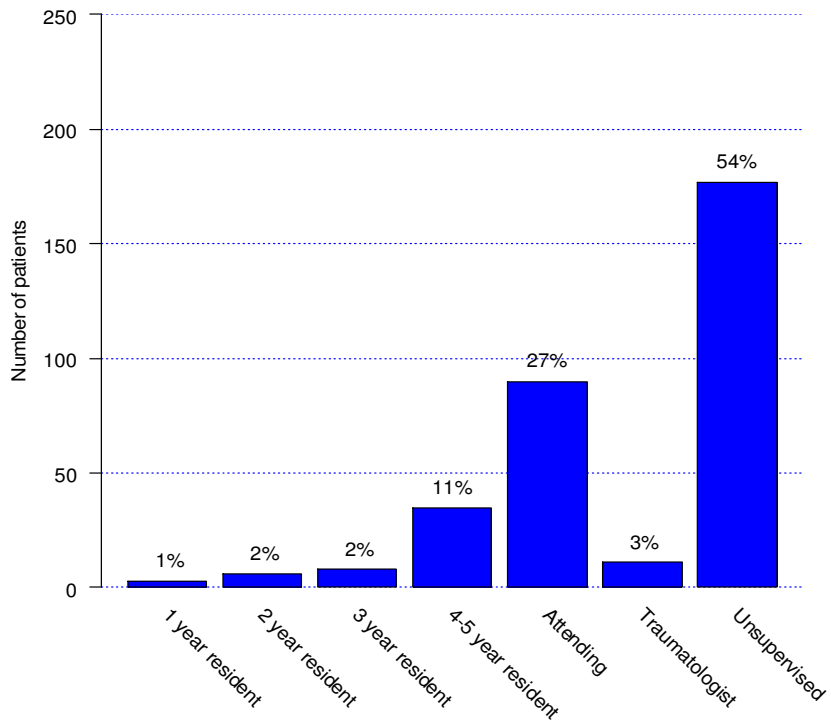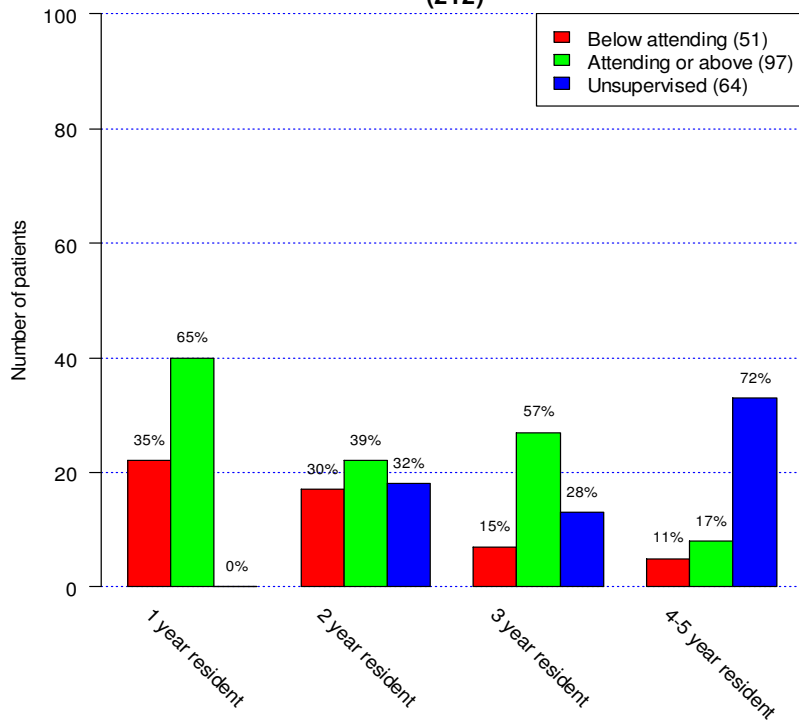**(678)**

Fracture classification for femur fractures
(678)

Distal femur

Method of osteosynthesis distal femur fractures (379)

Indication for reoperations of distal femur fractures (103)

Surgeon level for distal femur fractures
(387)
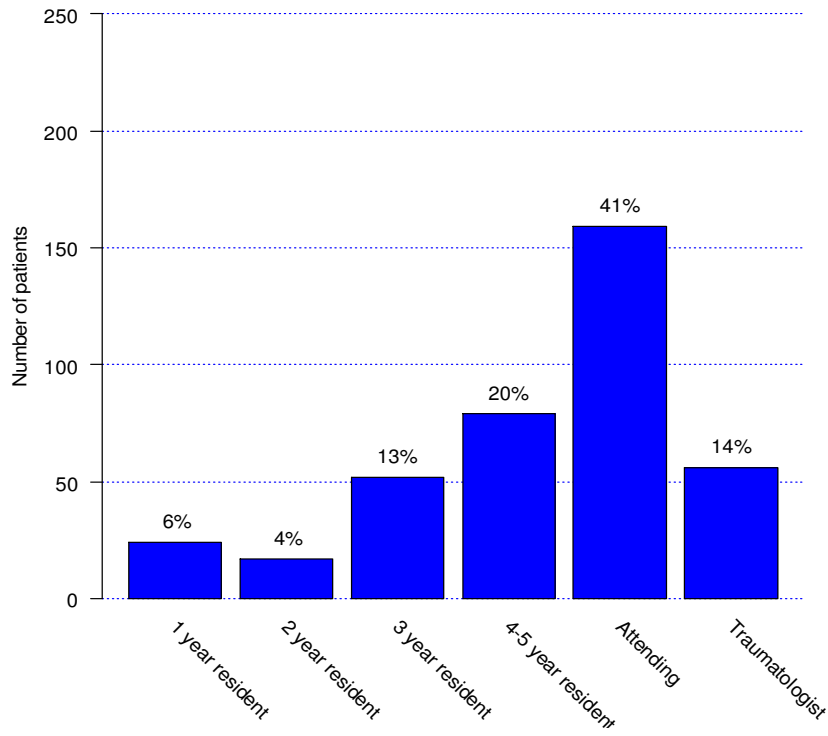
Level of supervision for distal femur fractures
(380)
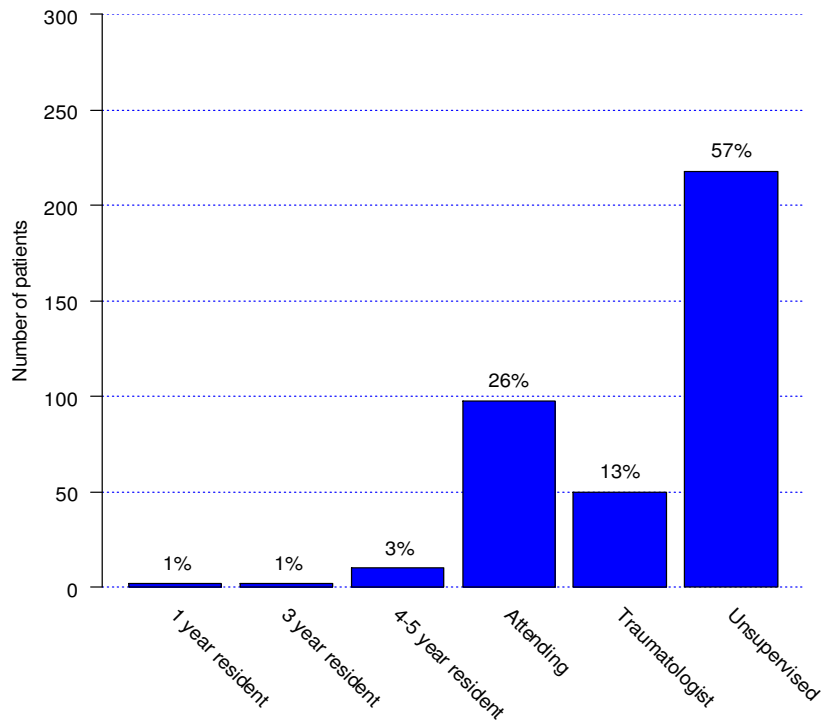
**Level of supervision for interns and residents
distal femur fractures
(171)**

Legend:
- Below attending (13)
- Attending or above (128)
- Unsupervised (30)
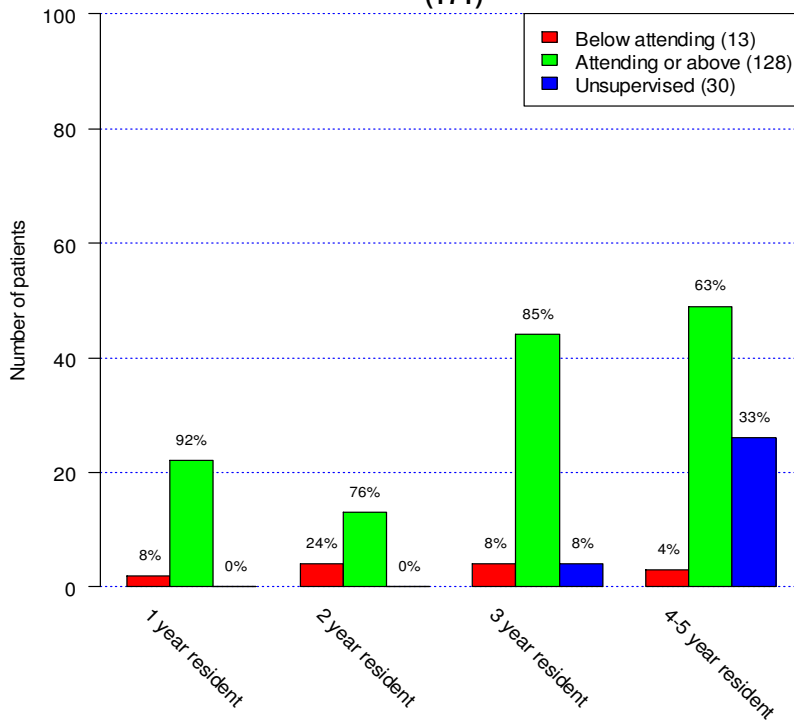
**Surgical delay for distal femur fractures
(350)**
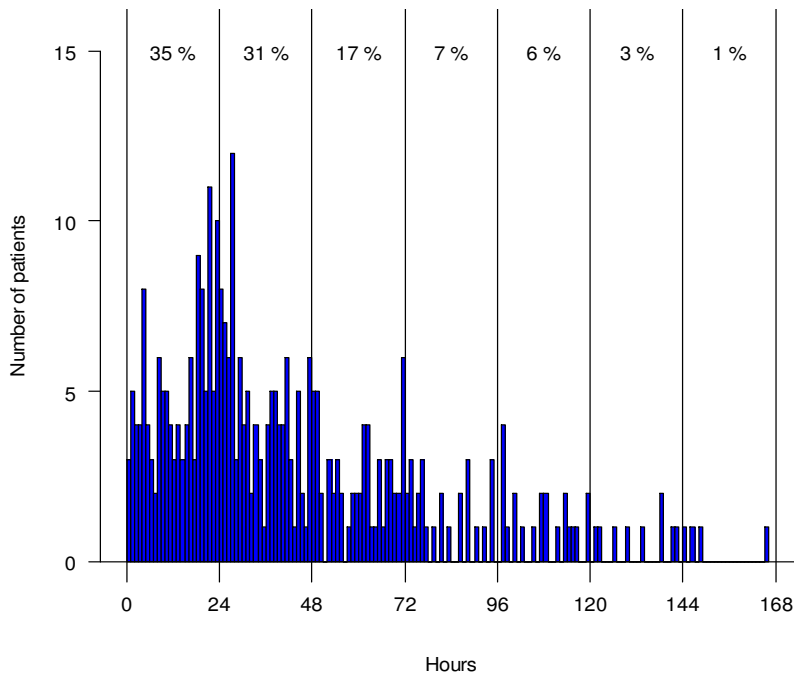
Hours

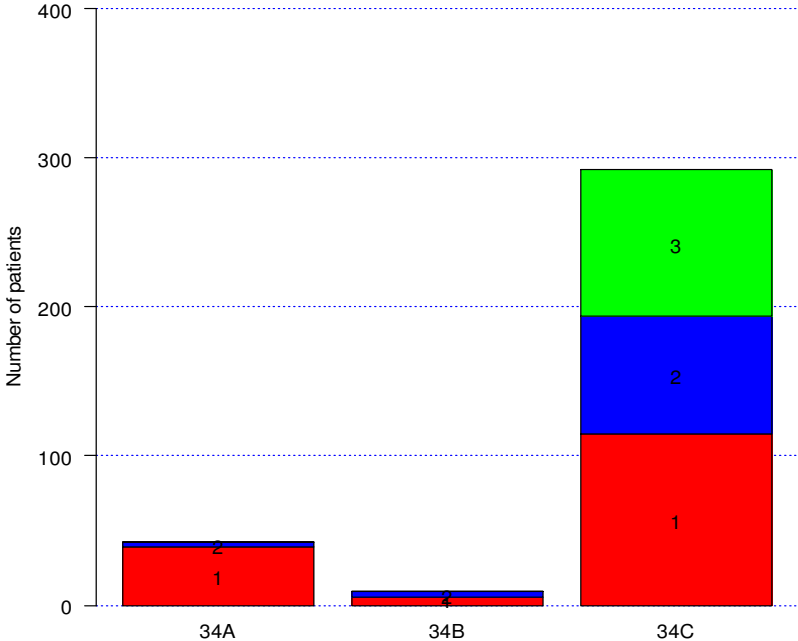(Proportion of patients operated in 24 hour intervals)

96

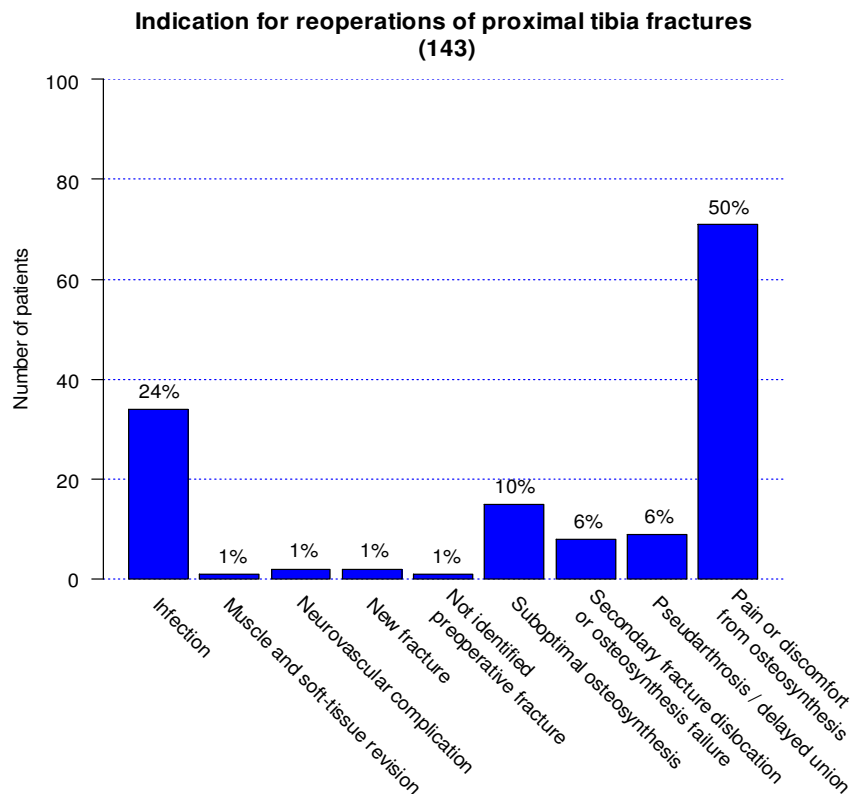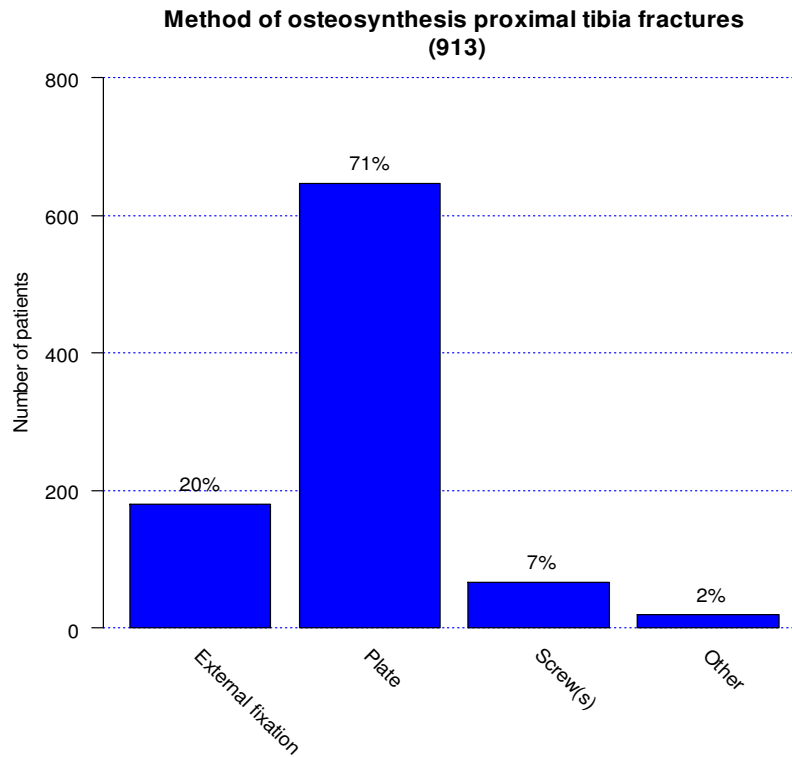**Survival for primary procedure with reoperation due to any reason**
distal femur fractures
(387)
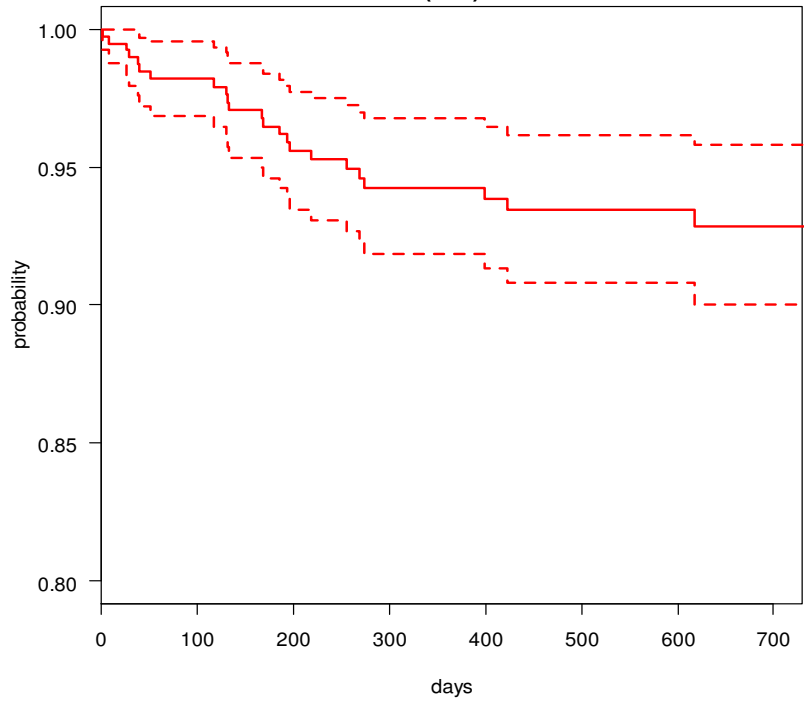
Survival for primary procedure with reoperation due to any reason
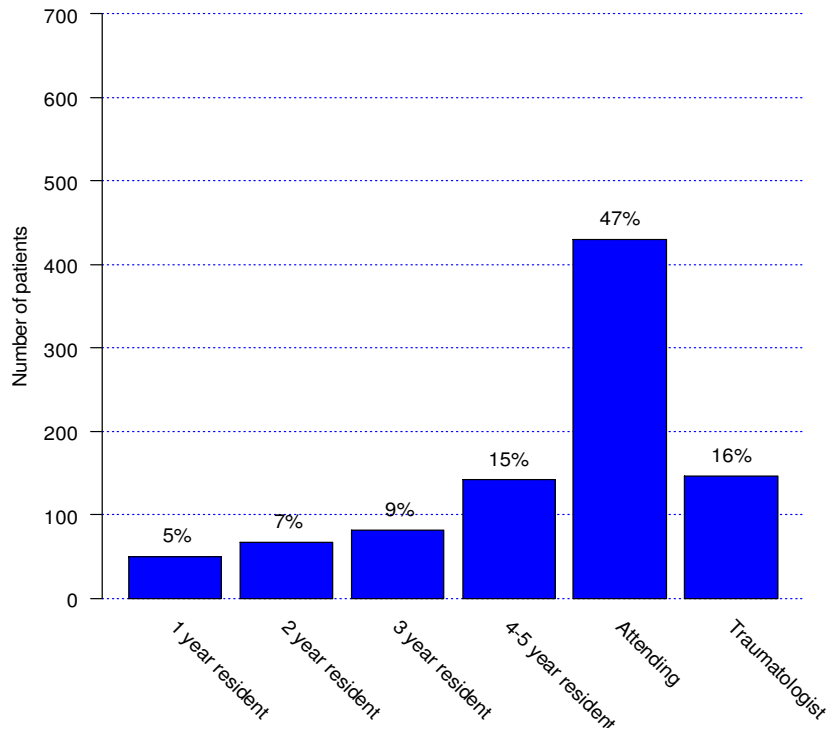**except pain and discomfort from surgical hardware**
distal femur fractures
(387)
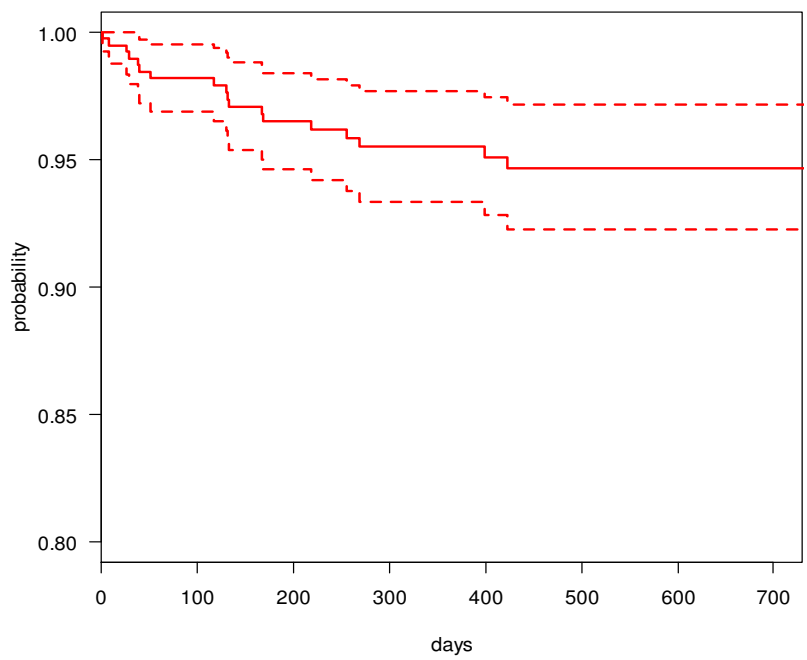
**Fracture classification for distal femur fractures
(387)**

Patella

**Method of osteosynthesis patella fractures
(343)**

**Indication for reoperations of patella fractures
(94)**

Surgeon level for patella fractures
(342)
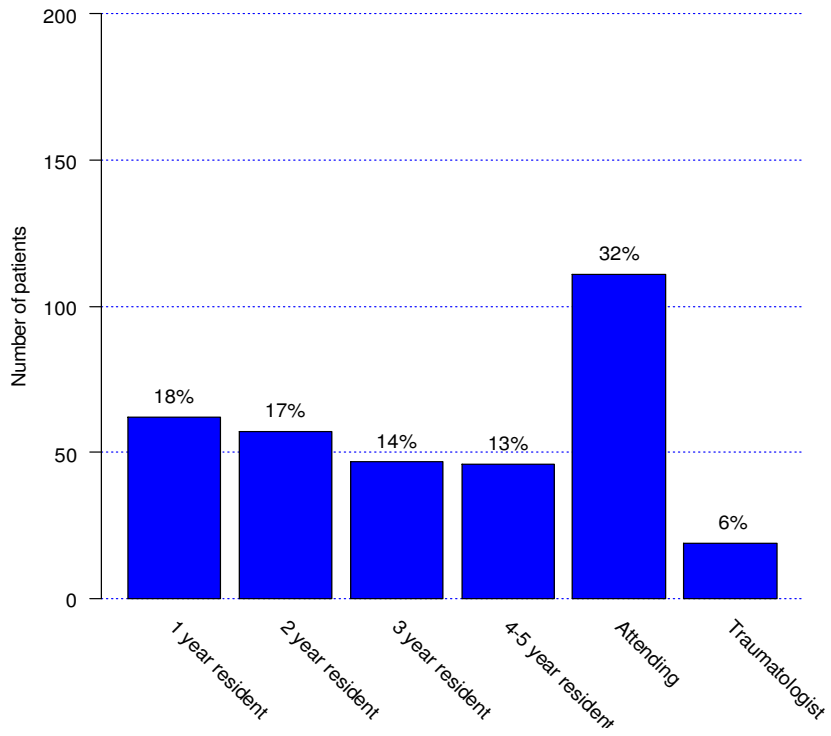
Level of supervision for patella fractures
(330)

**Level of supervision for interns and residents
patella fractures
(212)**

Legend:
- Below attending (51) — red
- Attending or above (97) — green
- Unsupervised (64) — blue

X-axis categories: 1 year resident, 2 year resident, 3 year resident, 4-5 year resident

Bar percentages:
- 1 year resident: 35%, 65%, 0%
- 2 year resident: 30%, 39%, 32%
- 3 year resident: 15%, 57%, 28%
- 4-5 year resident: 11%, 17%, 72%

Y-axis: Number of patients

**Surgical delay for patella fractures
(311)**
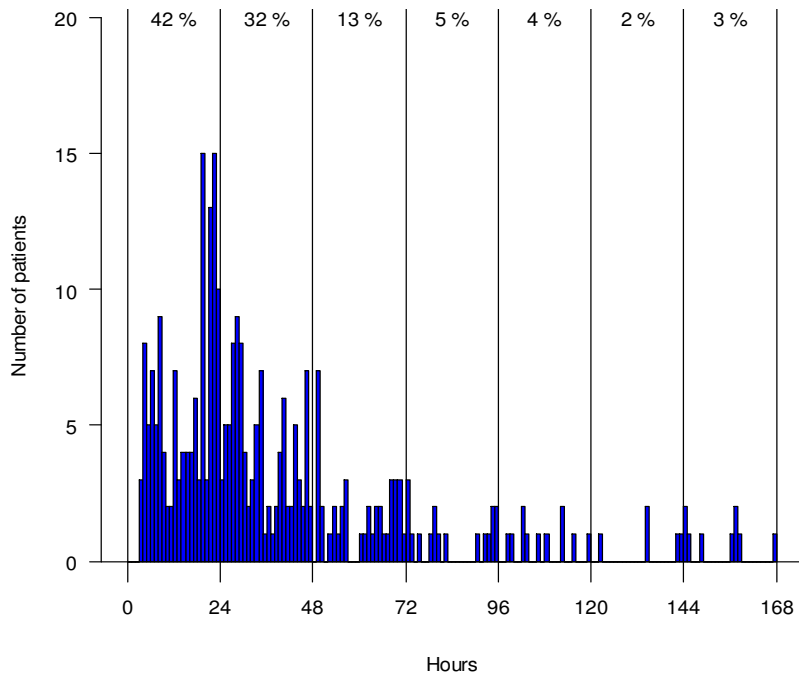
Percentages across top: 42 %, 32 %, 13 %, 5 %, 4 %, 2 %, 3 %

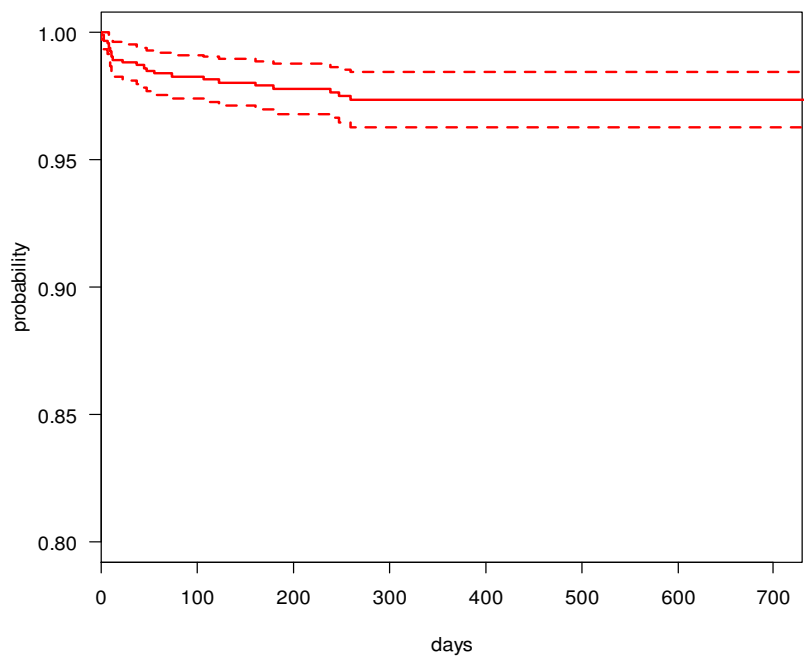X-axis: Hours (0, 24, 48, 72, 96, 120, 144, 168)
Y-axis: Number of patients

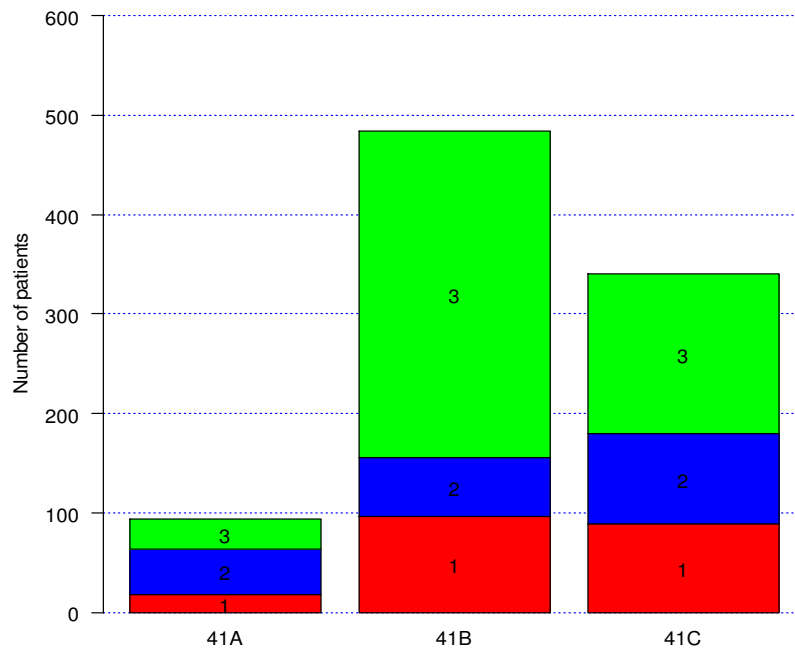(Proportion of patients operated in 24 hour intervals)

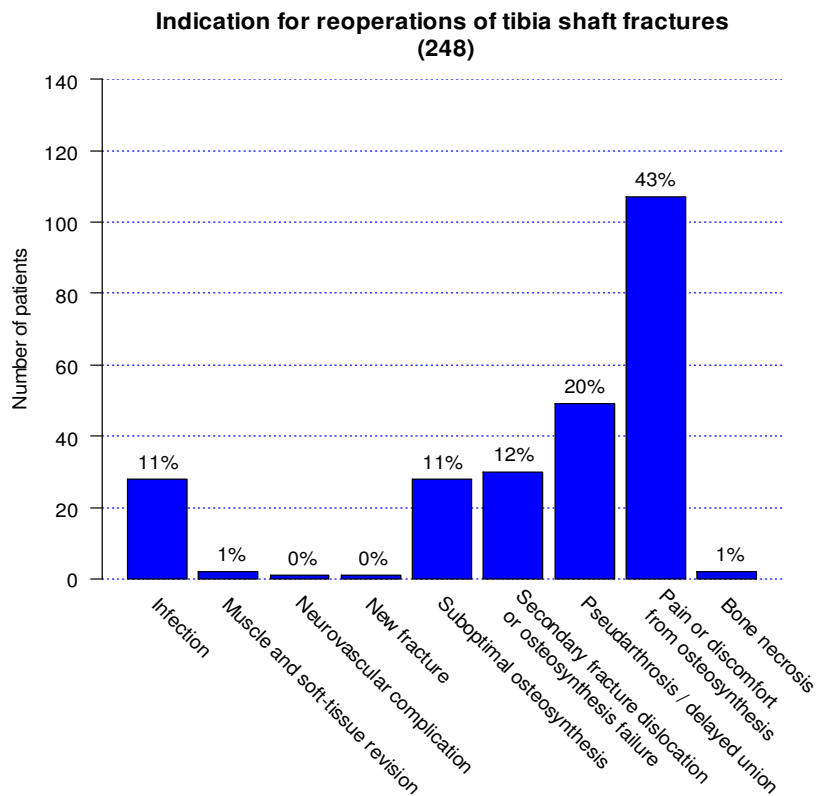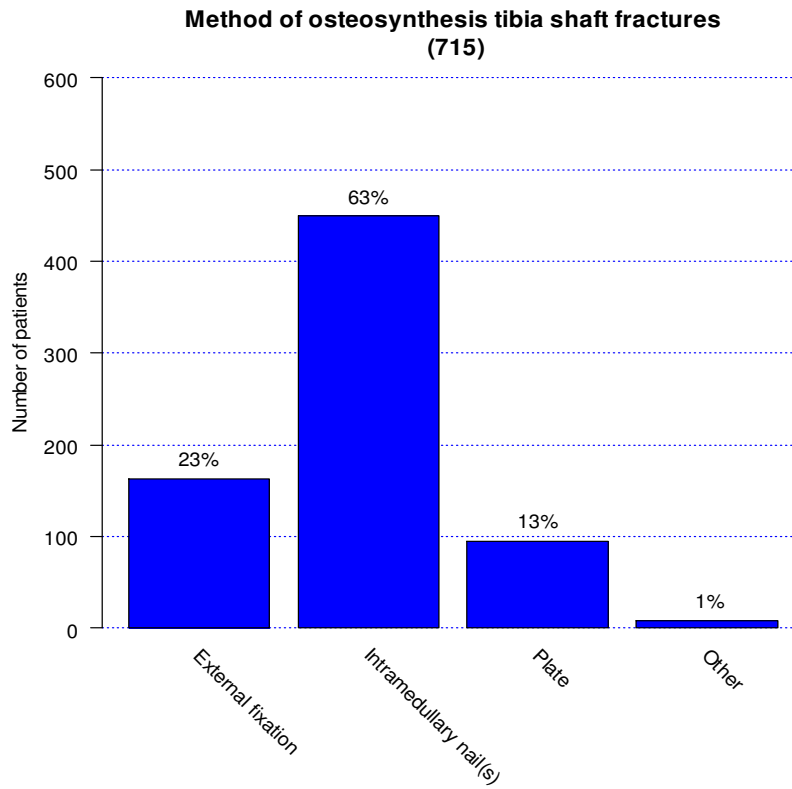## Survival for primary procedure with reoperation due to any reason
patella fractures
(343)
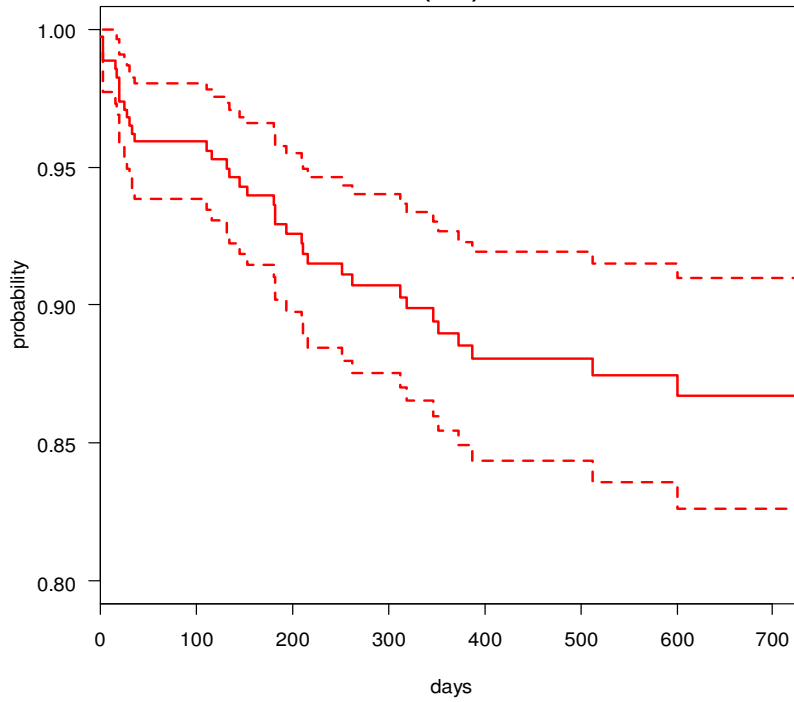
Survival for primary procedure with reoperation due to any reason
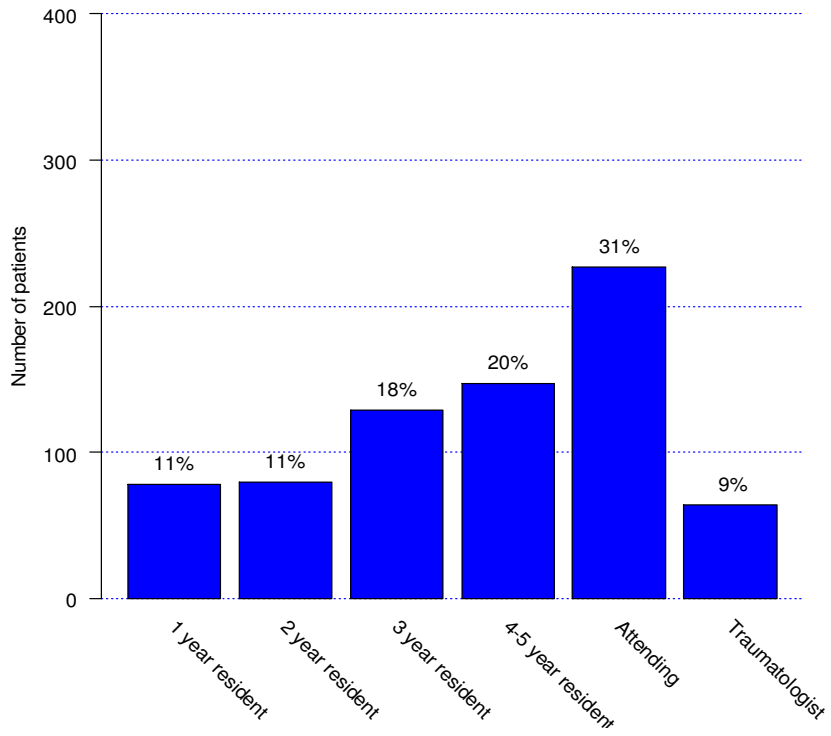## except pain and discomfort from surgical hardware
patella fractures
(343)
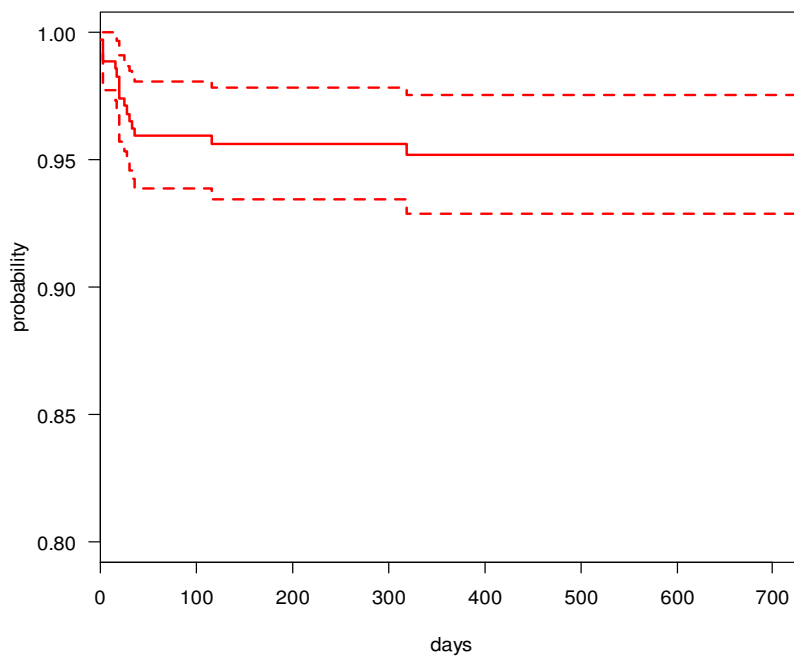
**Fracture classification for patella fractures
(343)**

Proximal tibia

Method of osteosynthesis proximal tibia fractures
(913)

Indication for reoperations of proximal tibia fractures
(143)

Surgeon level for proximal tibia fractures
(917)

Bar chart showing "Number of patients" on the y-axis (0 to 700) and surgeon level categories on the x-axis:
- 1 year resident: 5%
- 2 year resident: 7%
- 3 year resident: 9%
- 4-5 year resident: 15%
- Attending: 47%
- Traumatologist: 16%

Level of supervision for proximal tibia fractures
(897)

Bar chart showing "Number of patients" on the y-axis (0 to 600) and supervision level categories on the x-axis:
- 3 year resident: 0%
- 4-5 year resident: 1%
- Attending: 30%
- Traumatologist: 11%
- Unsupervised: 58%

Level of supervision for interns and residents proximal tibia fractures (340)

Legend:
- Below attending (12)
- Attending or above (280)
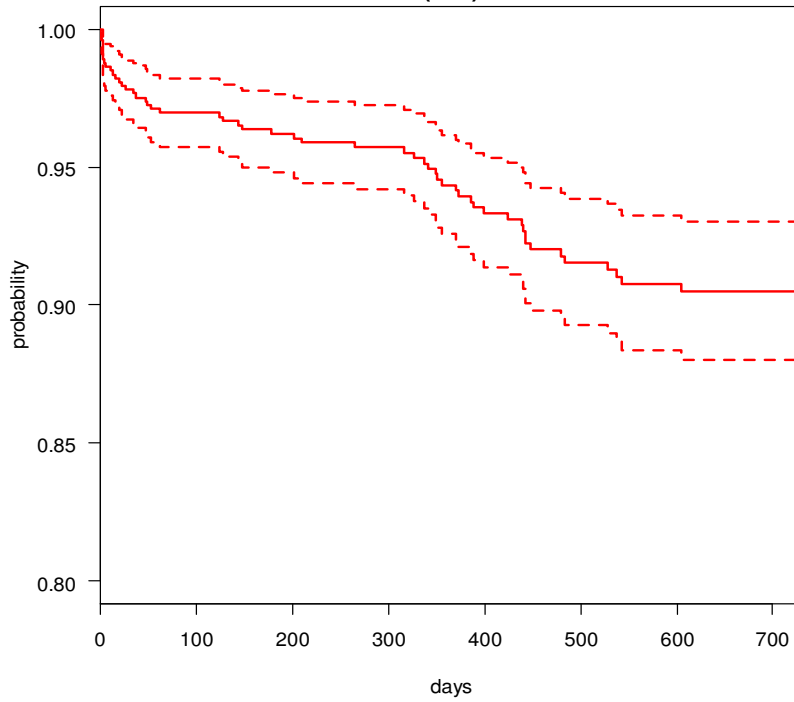- Unsupervised (48)
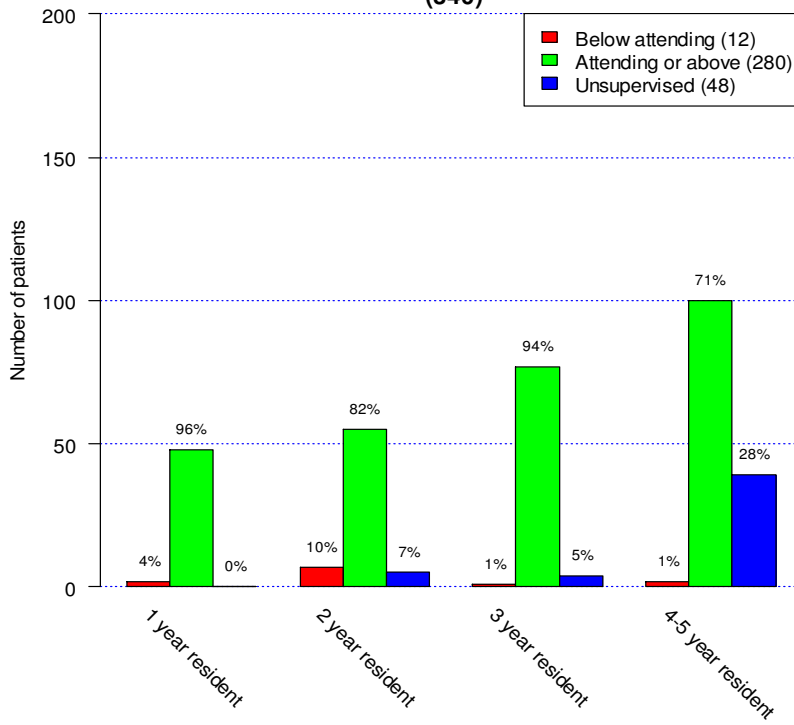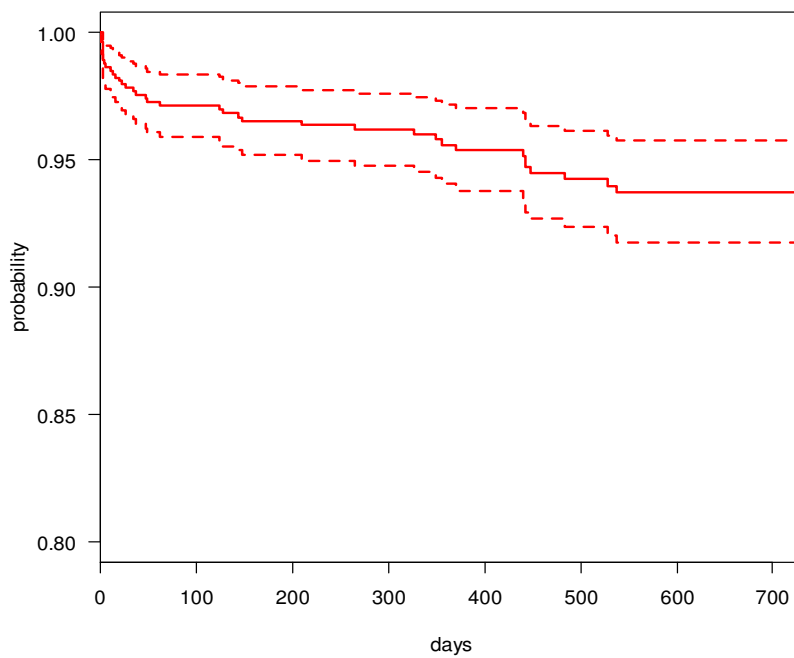
Surgical delay for proximal tibia fractures (785)
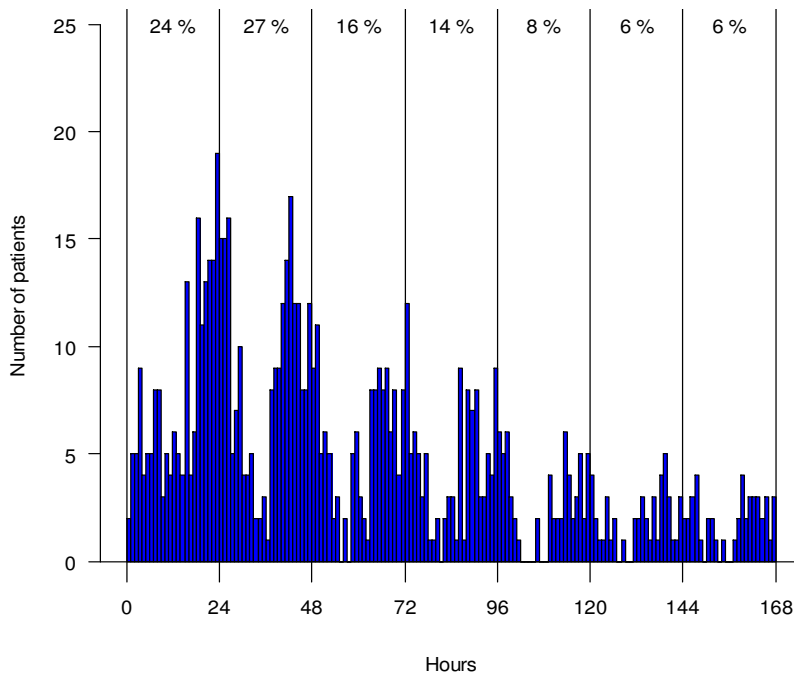
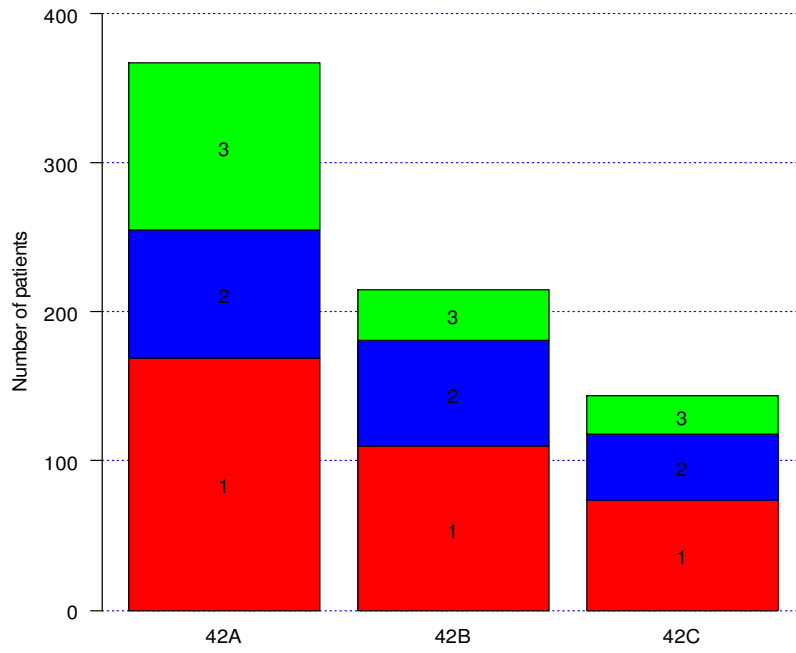(Proportion of patients operated in 24 hour intervals)

Survival for primary procedure with reoperation due to any reason
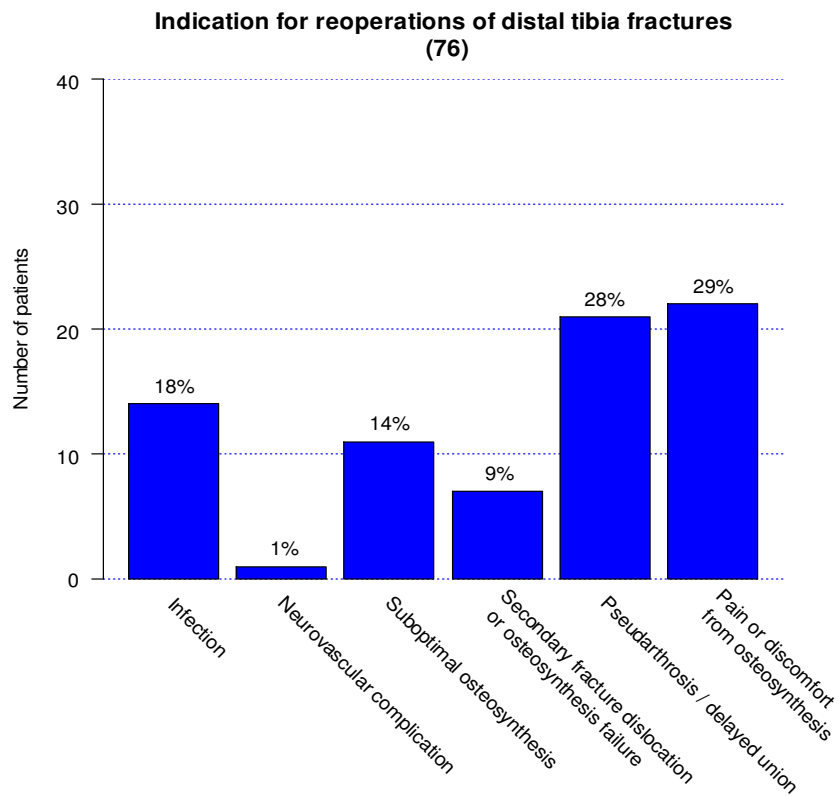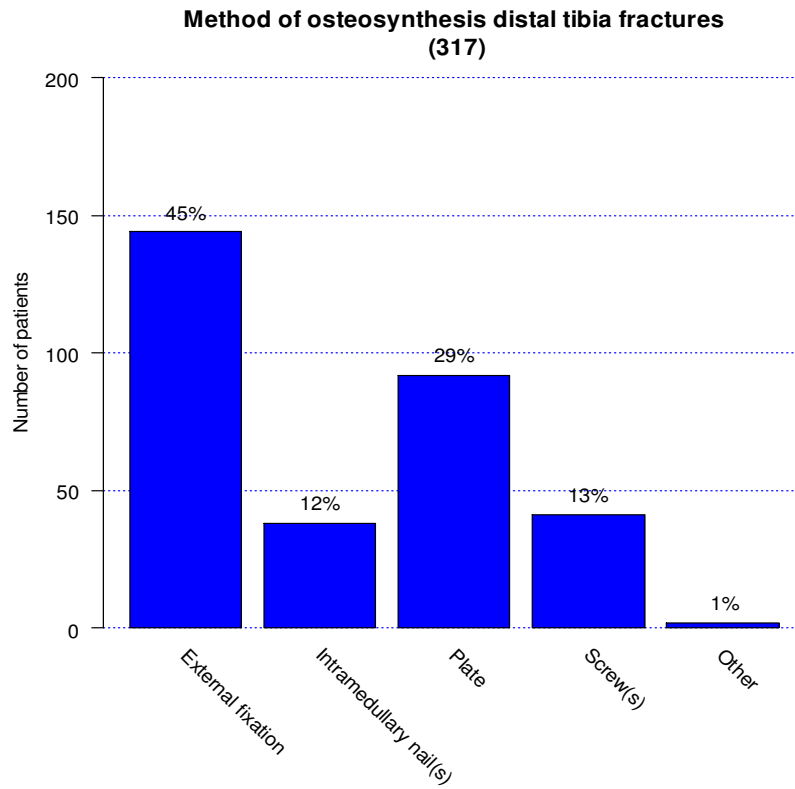**proximal tibia fractures**
(918)
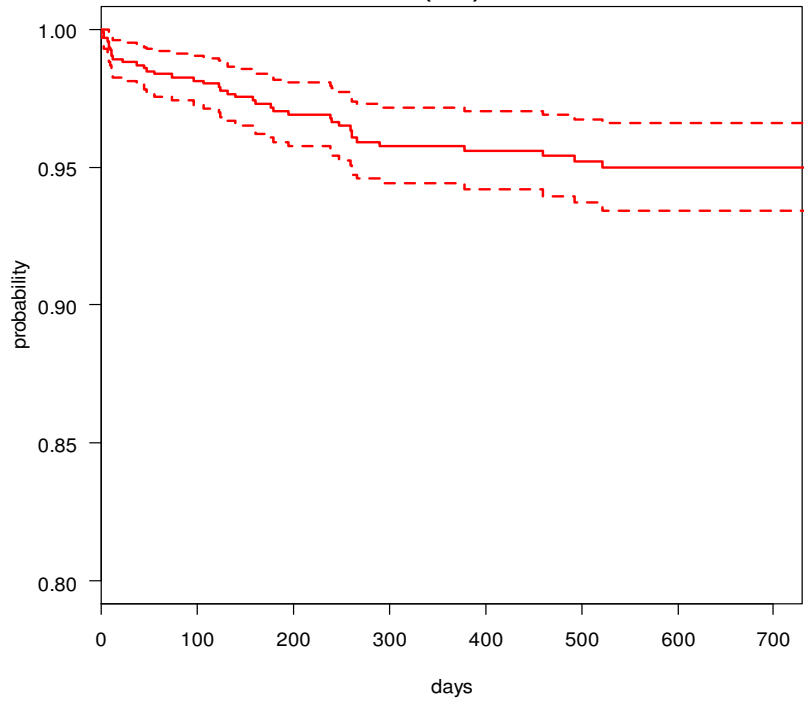
Survival for primary procedure with reoperation due to any reason
**except pain and discomfort from surgical hardware**
proximal tibia fractures
(918)

Fracture classification for proximal tibia fractures
(918)

Tibia shaft

**Method of osteosynthesis tibia shaft fractures
(715)**

(Bar chart, y-axis "Number of patients" ranging 0–600)
- External fixation: 23%
- Intramedullary nail(s): 63%
- Plate: 13%
- Other: 1%

**Indication for reoperations of tibia shaft fractures
(248)**

(Bar chart, y-axis "Number of patients" ranging 0–140)
- Infection: 11%
- Muscle and soft-tissue revision: 1%
- Neurovascular complication: 0%
- New fracture: 0%
- Suboptimal osteosynthesis: 11%
- Secondary fracture dislocation or osteosynthesis failure: 12%
- Pseudarthrosis / delayed union: 20%
- Pain or discomfort from osteosynthesis: 43%
- Bone necrosis: 1%

Surgeon level for tibia shaft fractures
(725)

Level of supervision for tibia shaft fractures
(718)
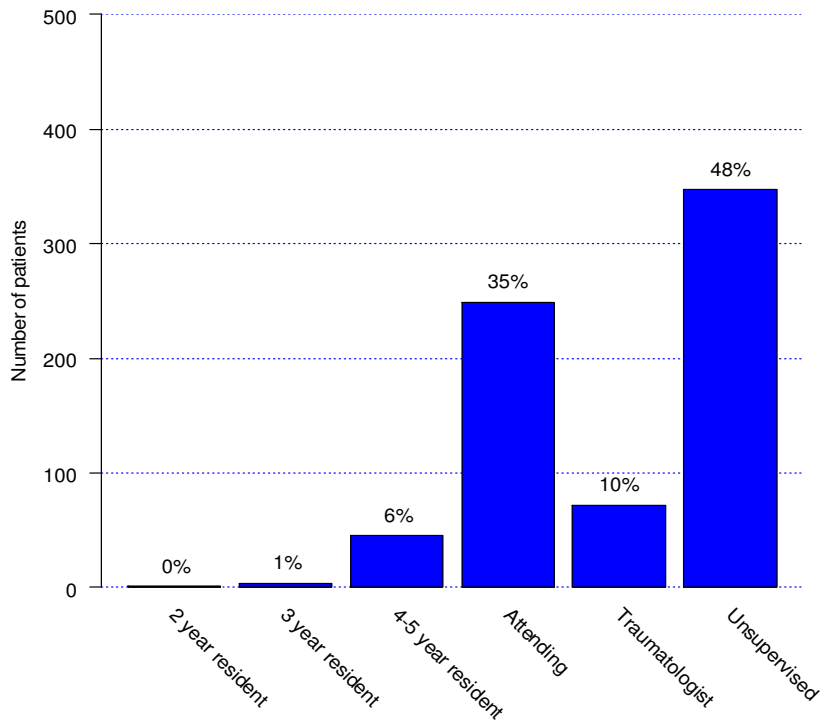
Level of supervision for interns and residents
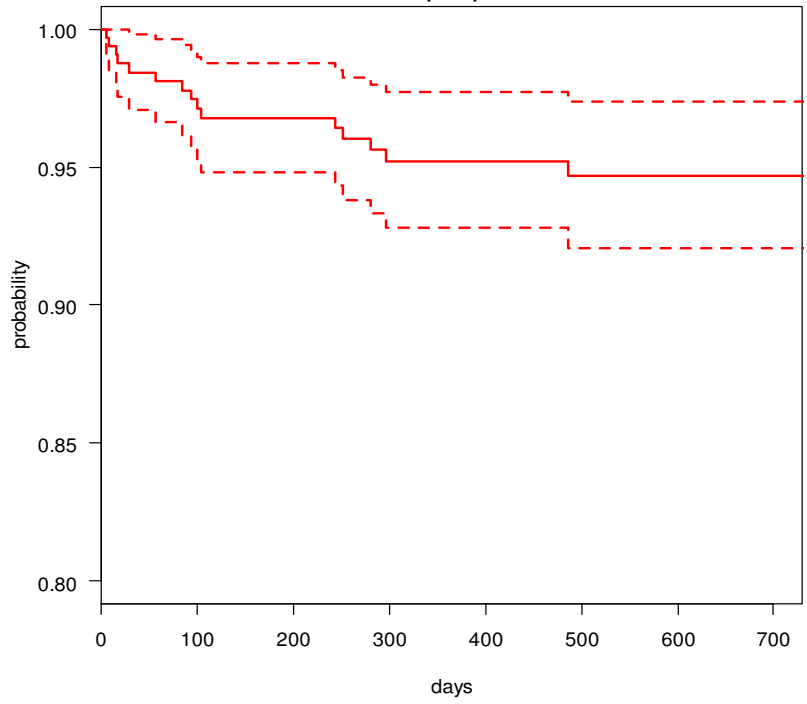## tibia shaft fractures
(433)
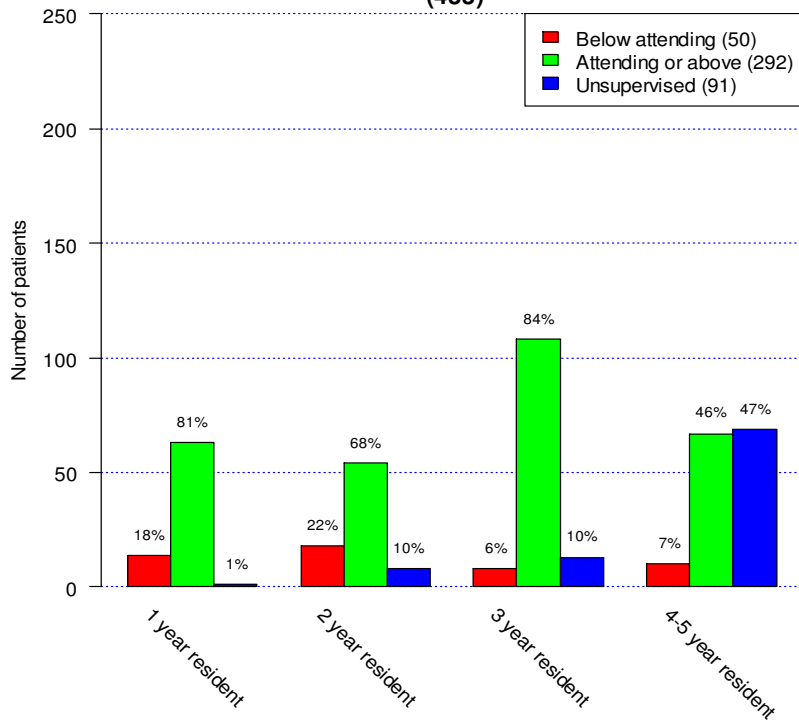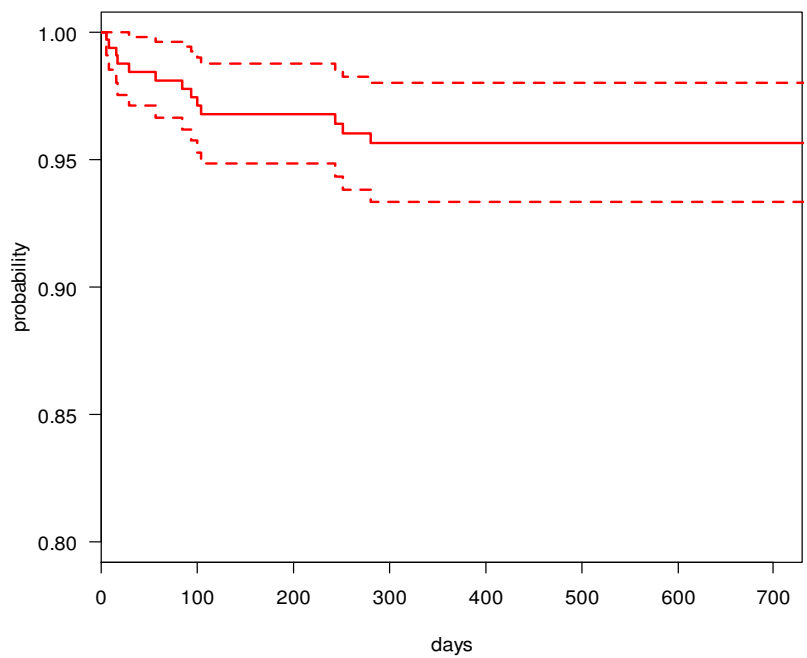

Surgical delay for tibia shaft fractures
(655)
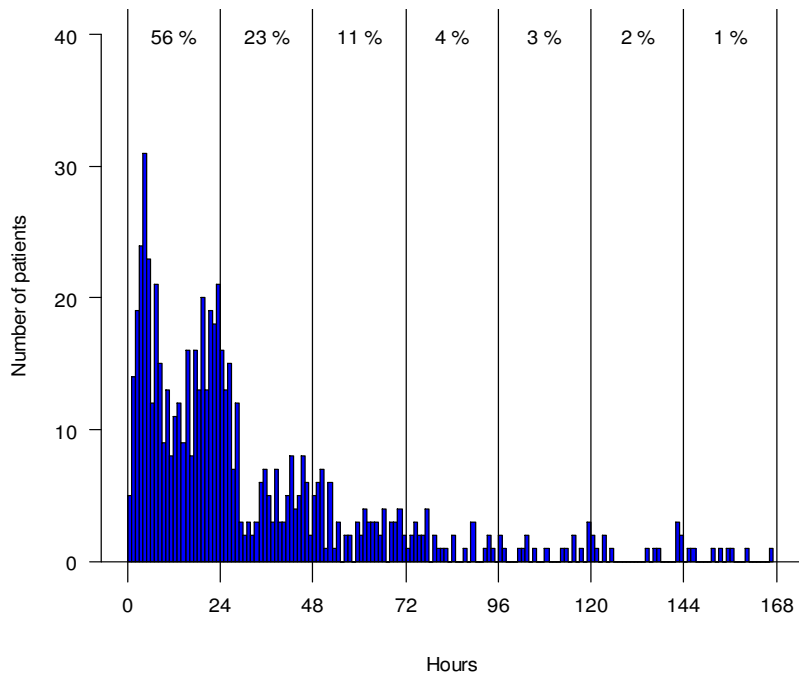
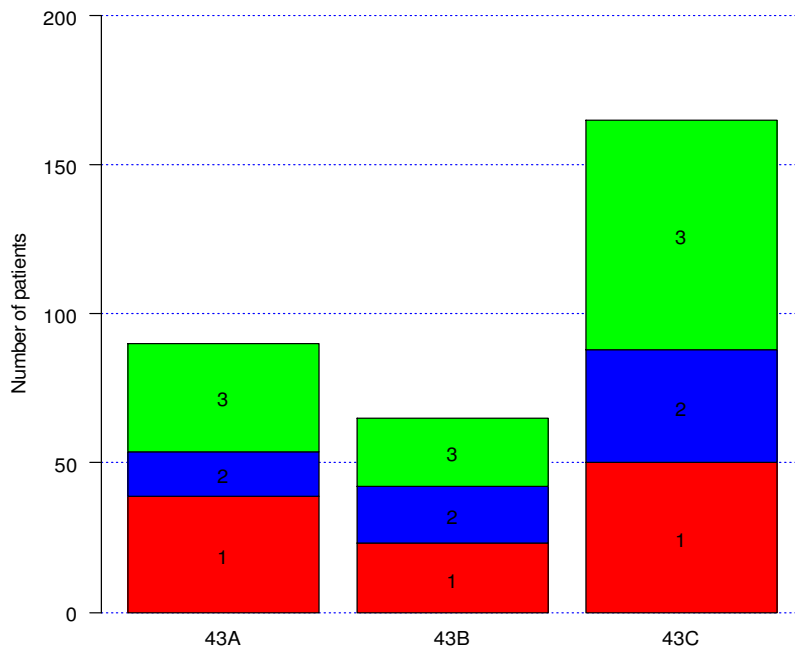(Proportion of patients operated in 24 hour intervals)

Survival for primary procedure with reoperation due to any reason
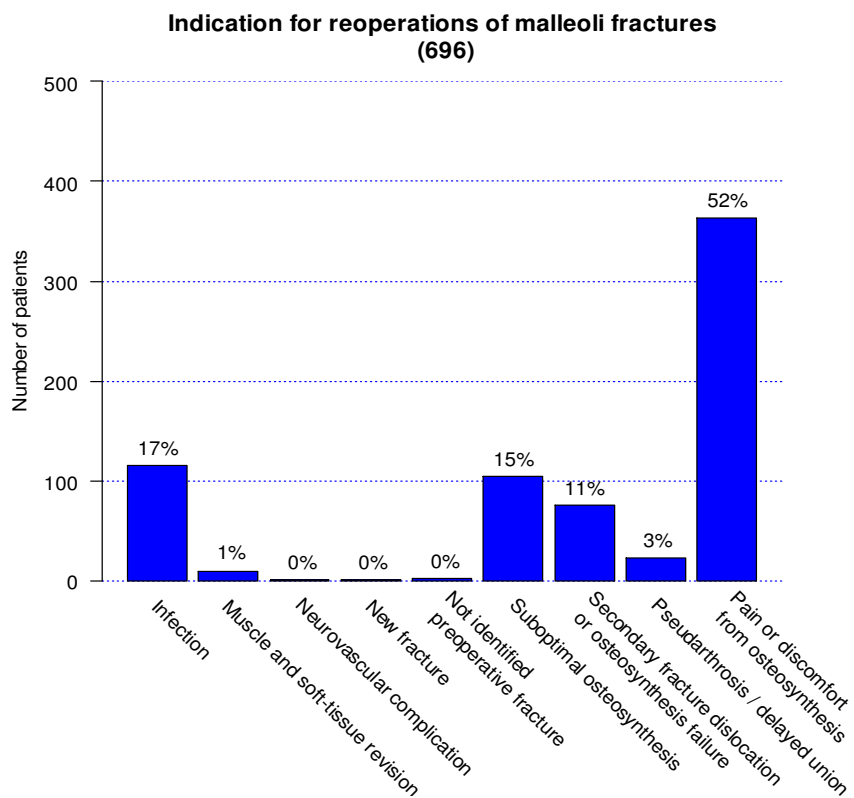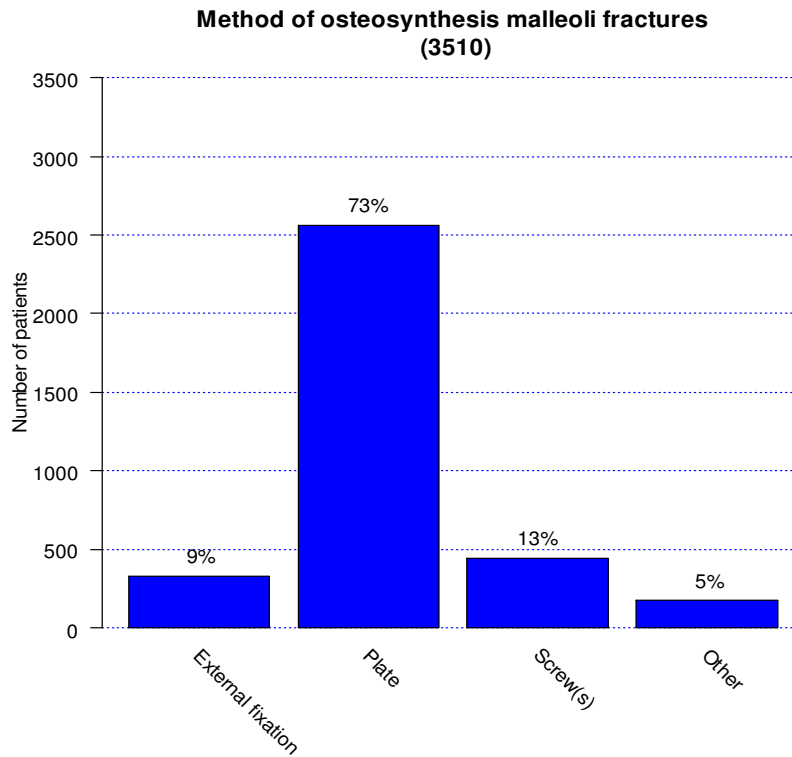**tibia shaft fractures**
(726)

Survival for primary procedure with reoperation due to any reason
**except pain and discomfort from surgical hardware**
tibia shaft fractures
(726)

Fracture classification for tibia shaft fractures (726)

Distal tibia

**Method of osteosynthesis distal tibia fractures
(317)**

**Indication for reoperations of distal tibia fractures
(76)**

Surgeon level for distal tibia fractures
(320)
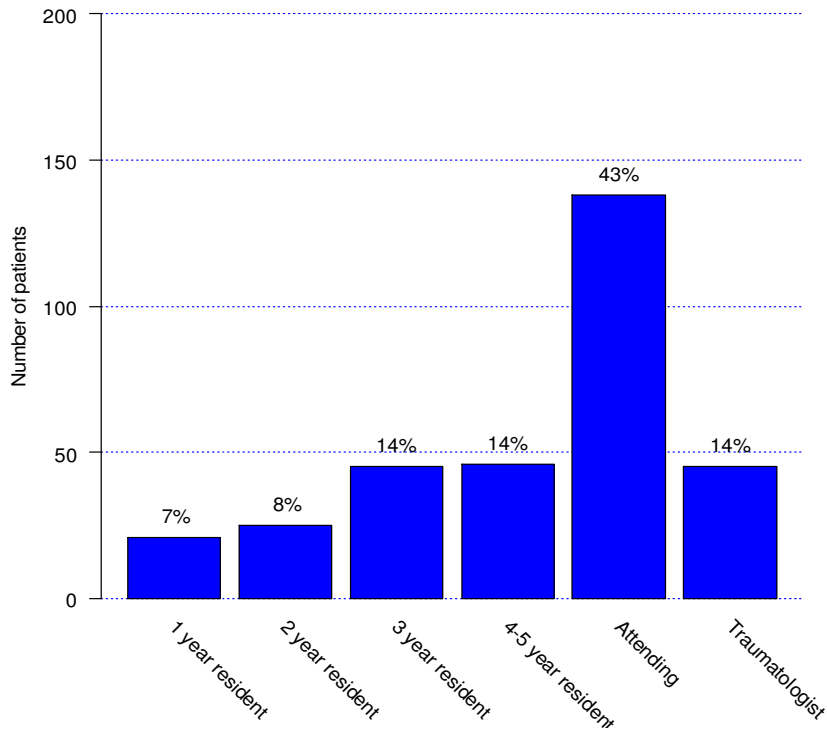
Level of supervision for distal tibia fractures
(313)
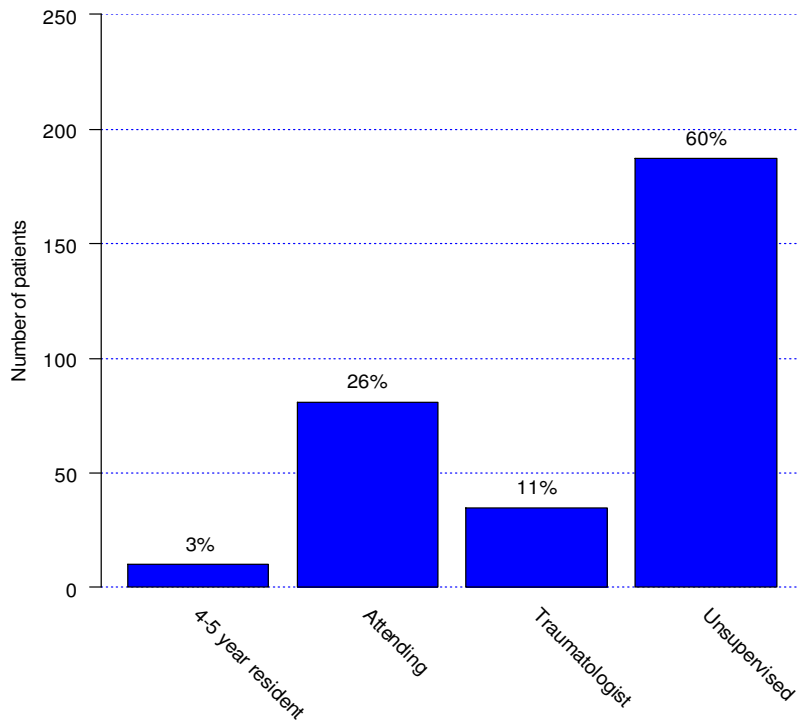
Level of supervision for interns and residents distal tibia fractures
(136)

Legend:
- Below attending (10)
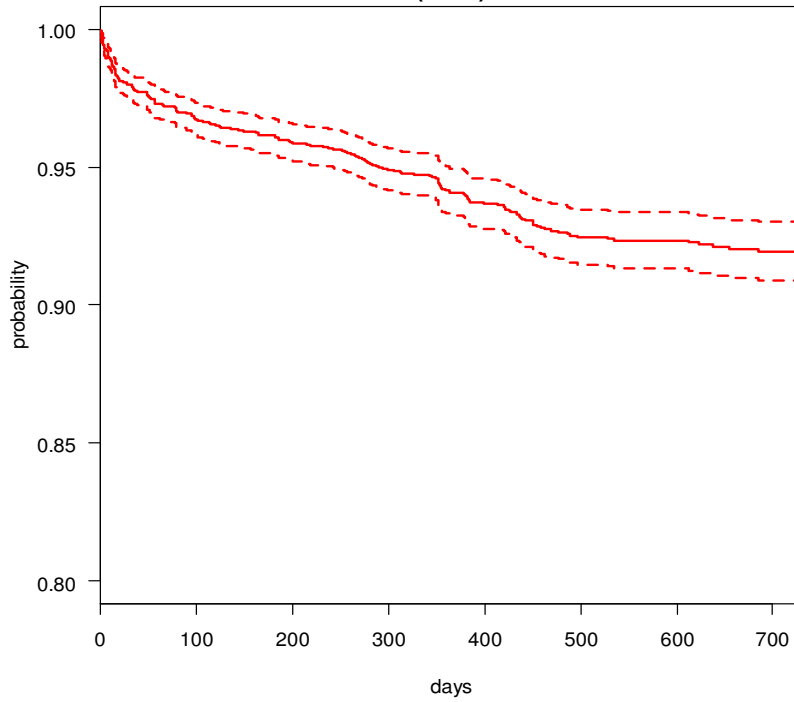- Attending or above (98)
- Unsupervised (28)
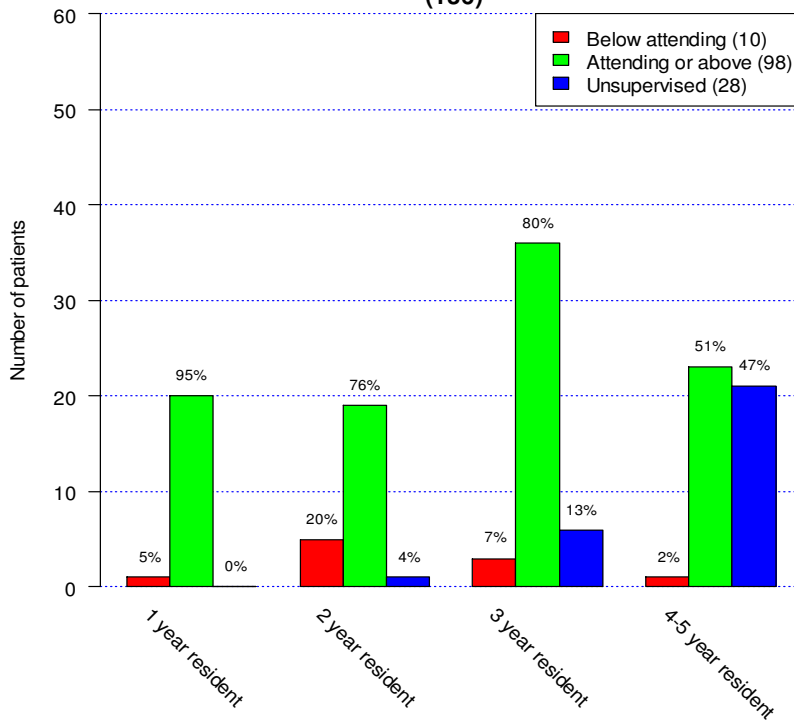
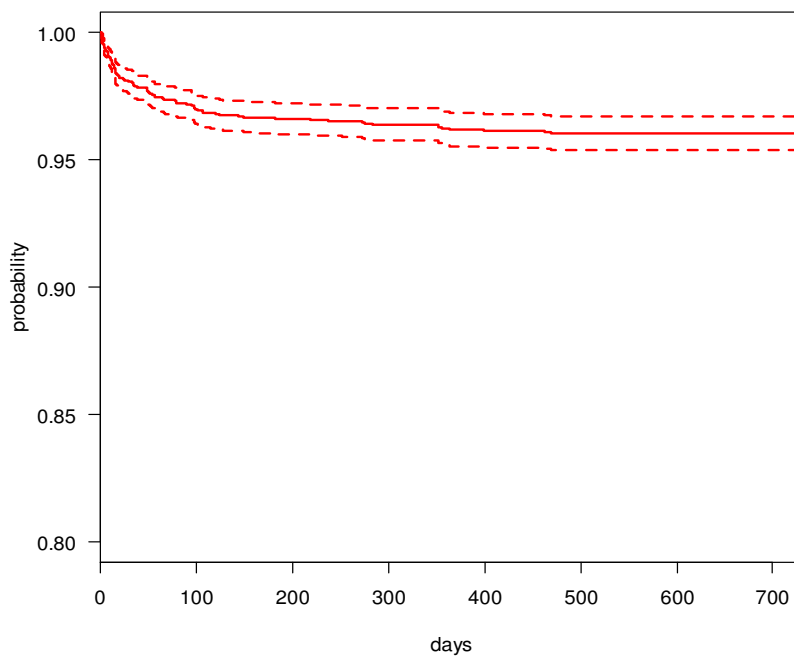## Surgical delay for distal tibia fractures
(281)
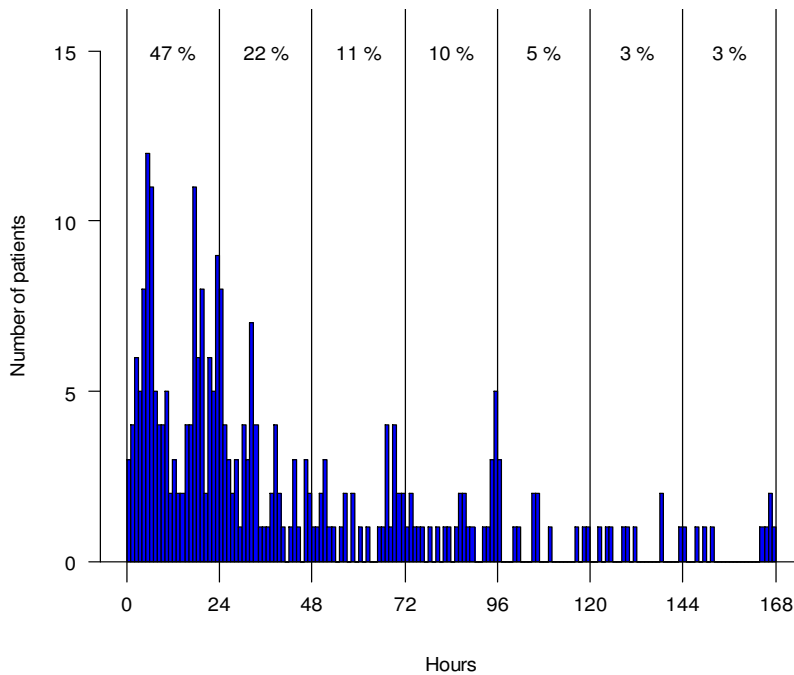
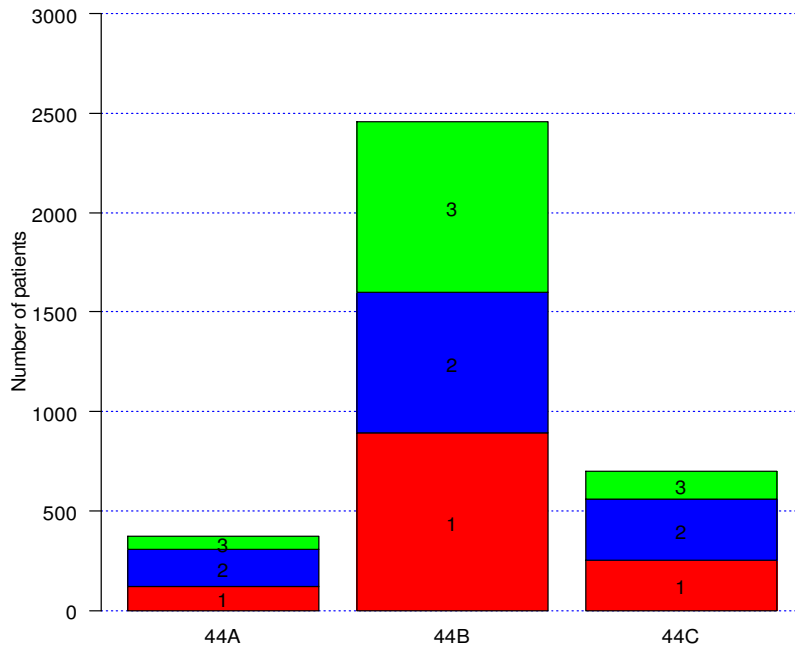(Proportion of patients operated in 24 hour intervals)

Survival for primary procedure with reoperation due to any reason
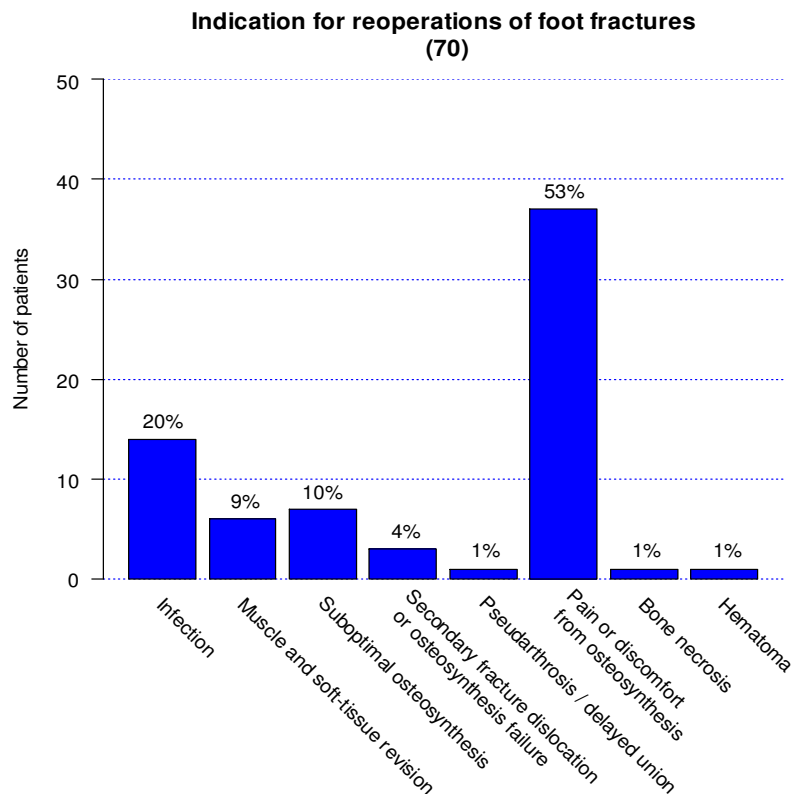**distal tibia fractures**
(320)

Survival for primary procedure with reoperation due to any reason
except pain and discomfort from surgical hardware
distal tibia fractures
(320)

Fracture classification for distal tibia fractures (320)

Malleoli

Method of osteosynthesis malleoli fractures (3510)

Indication for reoperations of malleoli fractures (696)

Surgeon level for malleoli fractures
(3531)
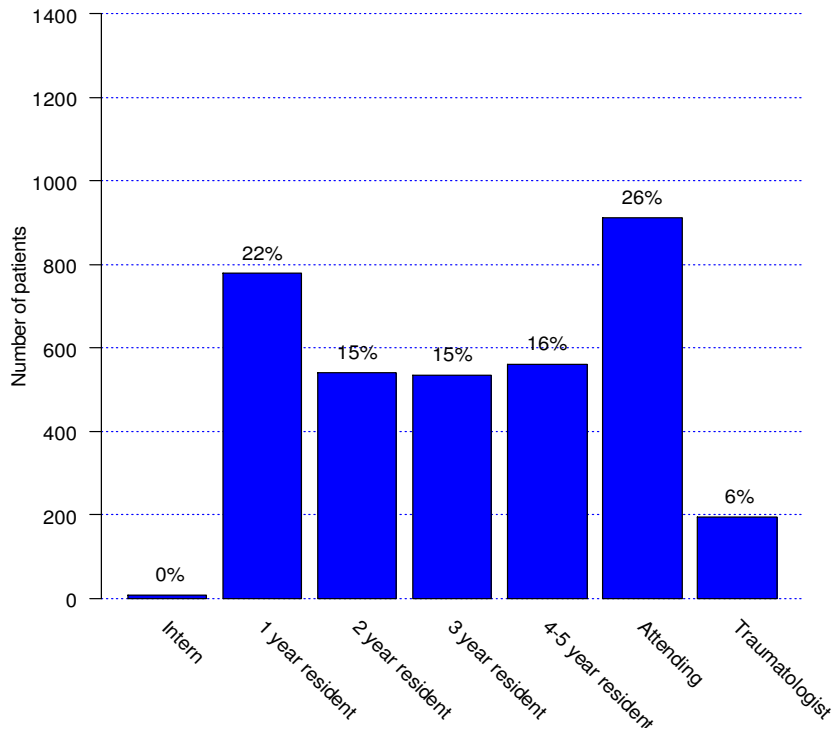
Level of supervision for malleoli fractures
(3461)
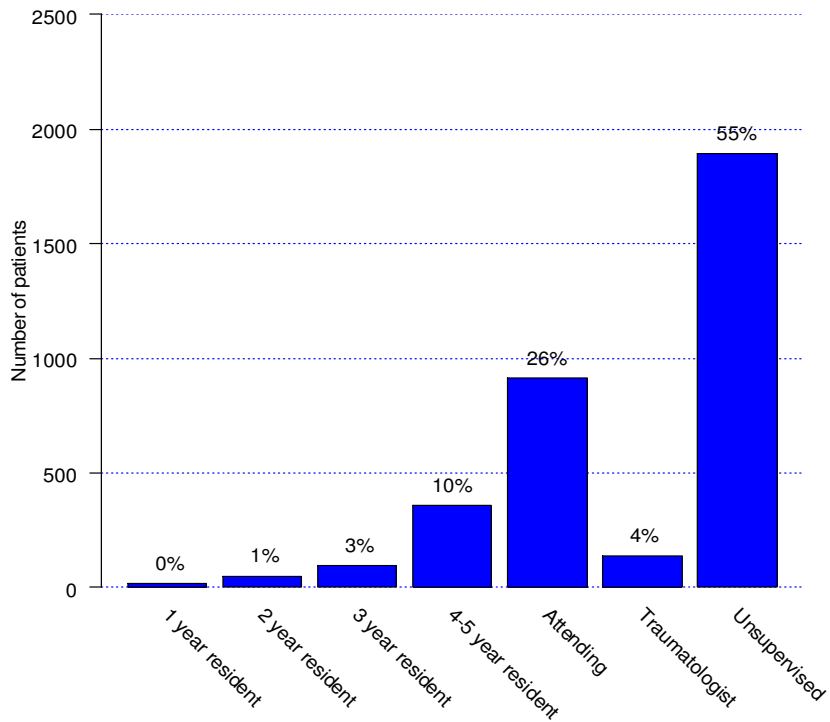
Level of supervision for interns and residents
malleoli fractures
(2416)

Legend:
- Below attending (515)
- Attending or above (1005)
- Unsupervised (896)
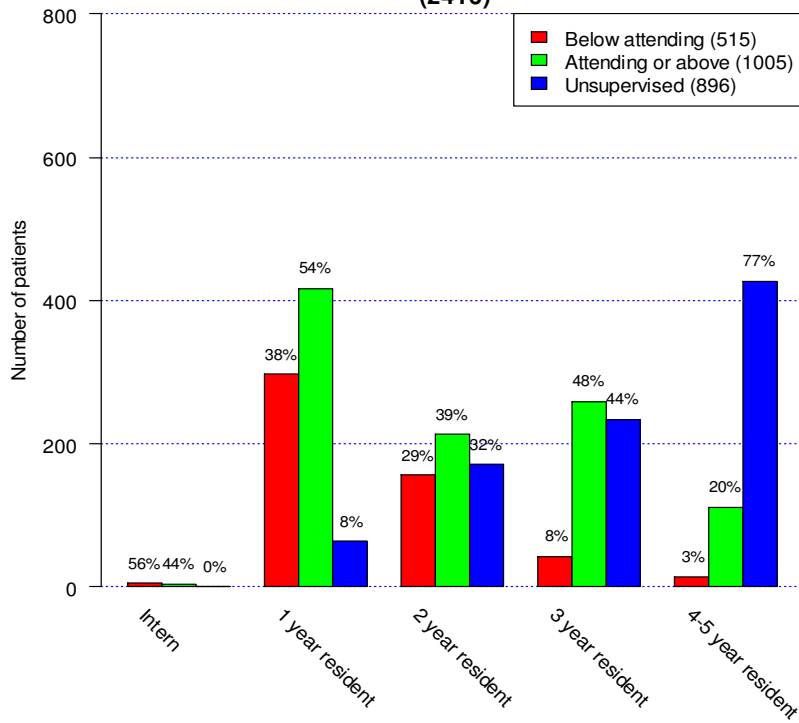
Surgical delay for malleoli fractures
(3227)
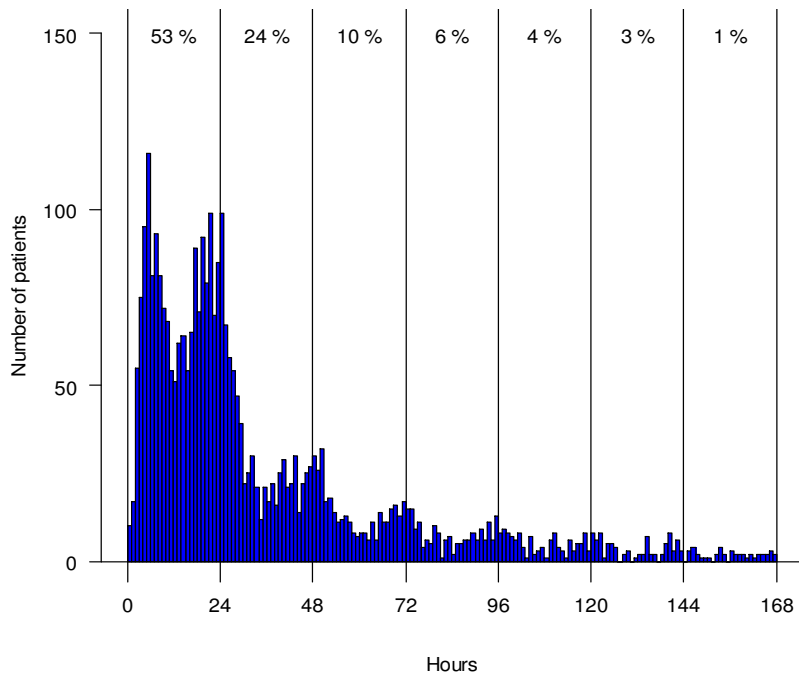
(Proportion of patients operated in 24 hour intervals)

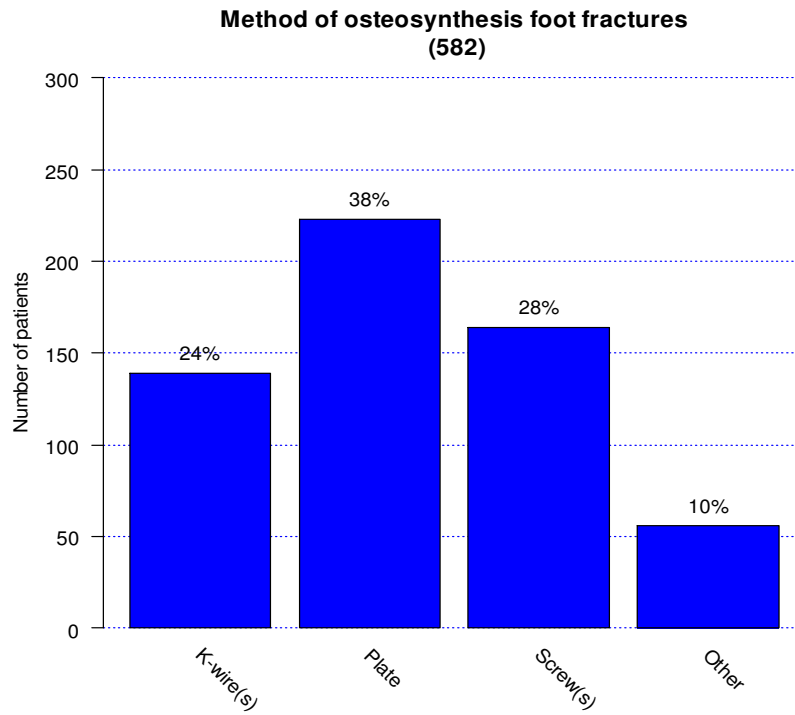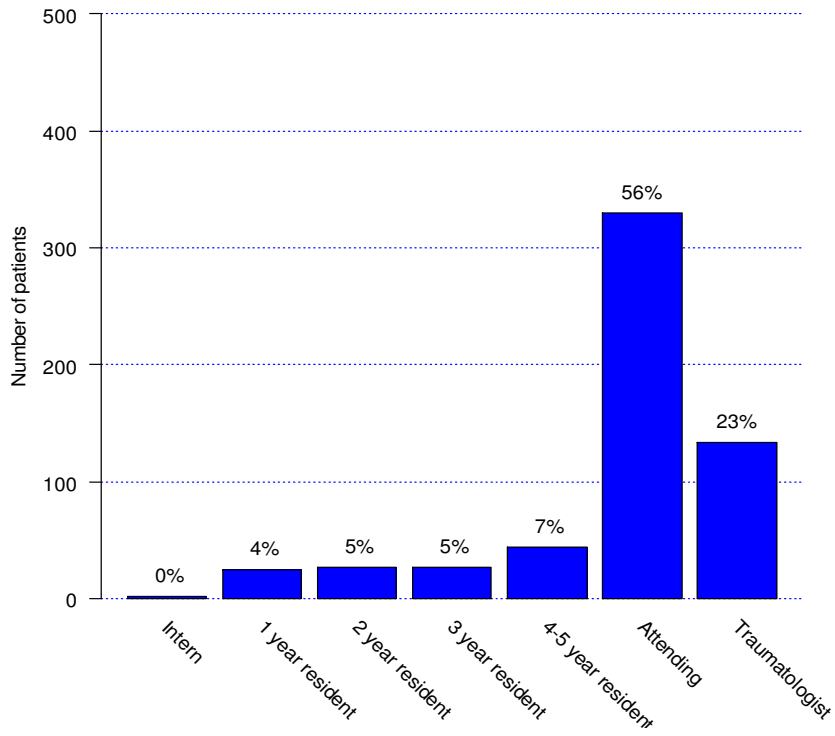**Survival for primary procedure with reoperation due to any reason**
malleoli fractures
(3533)

Survival for primary procedure with reoperation due to any reason
except pain and discomfort from surgical hardware
malleoli fractures
(3533)
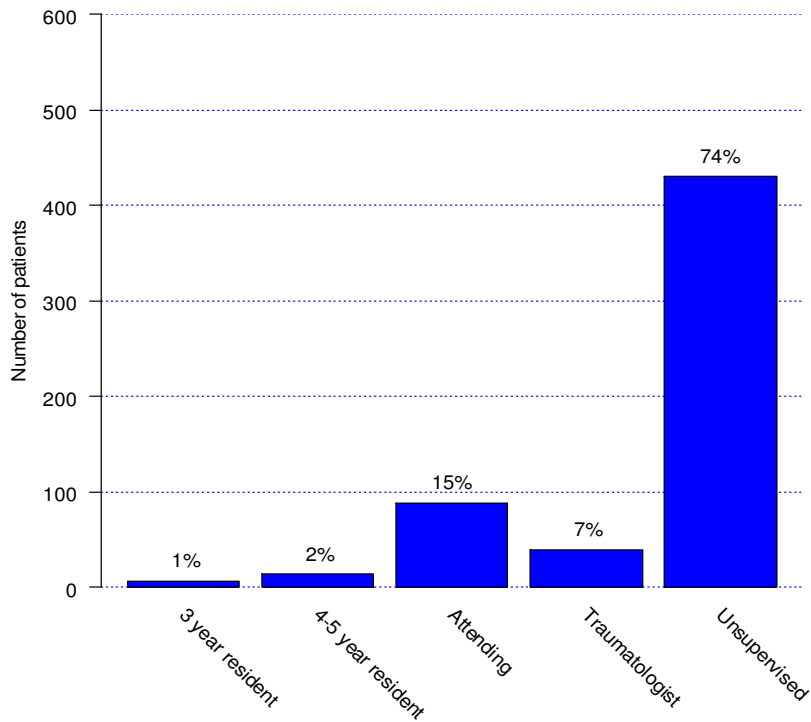
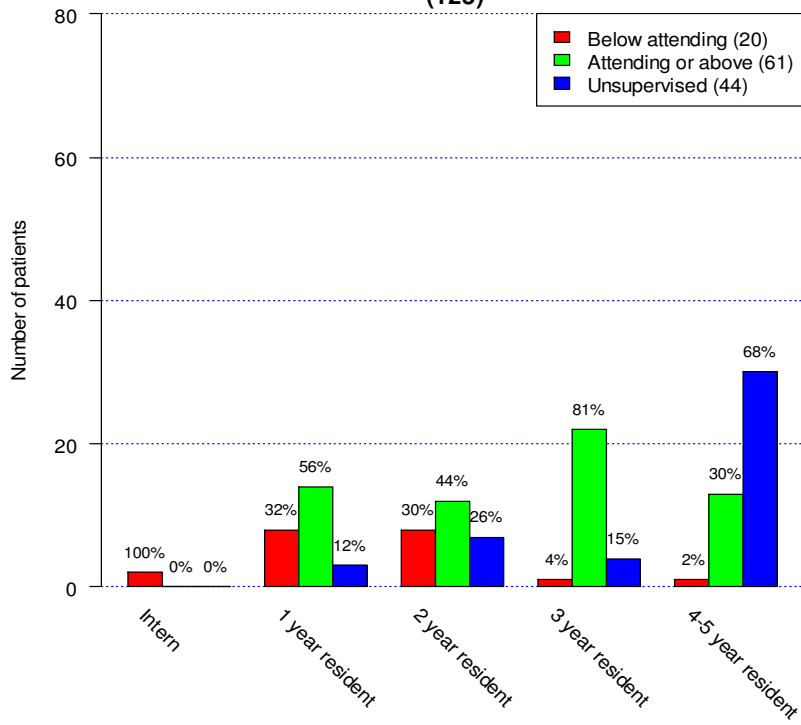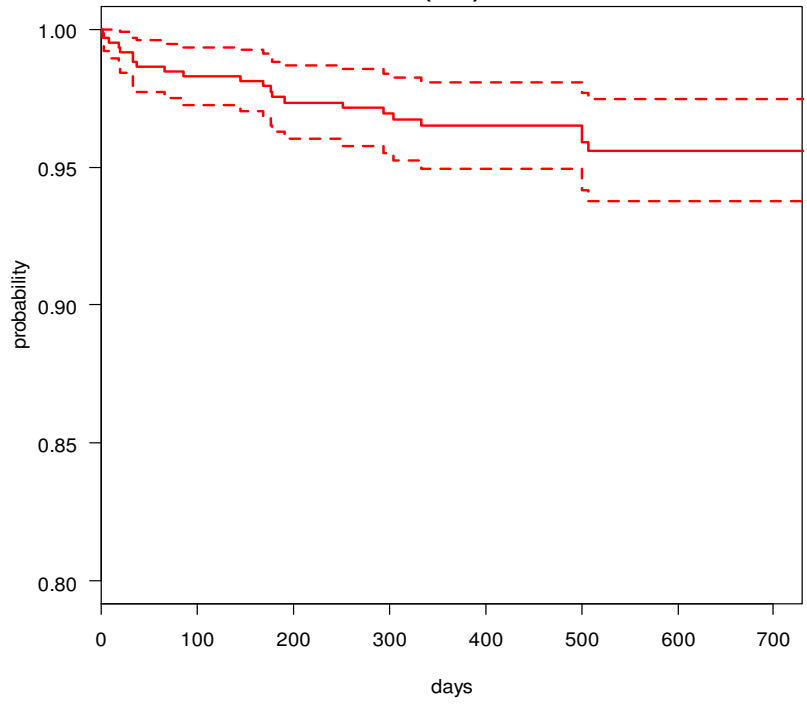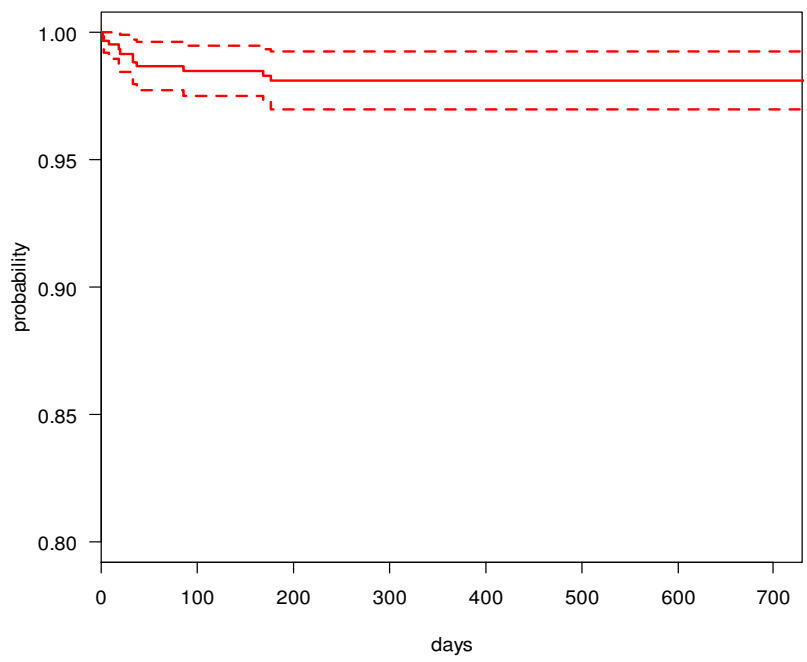**Fracture classification for malleoli fractures (3533)**

Foot

**Method of osteosynthesis foot fractures
(582)**

**Indication for reoperations of foot fractures
(70)**

Surgeon level for foot fractures
(589)

Bar chart — Number of patients by surgeon level:
- Intern: 0%
- 1 year resident: 4%
- 2 year resident: 5%
- 3 year resident: 5%
- 4-5 year resident: 7%
- Attending: 56%
- Traumatologist: 23%

Level of supervision for foot fractures
(580)

Bar chart — Number of patients by level of supervision:
- 3 year resident: 1%
- 4-5 year resident: 2%
- Attending: 15%
- Traumatologist: 7%
- Unsupervised: 74%

Level of supervision for interns and residents
foot fractures
(125)

Surgical delay for foot fractures
(376)
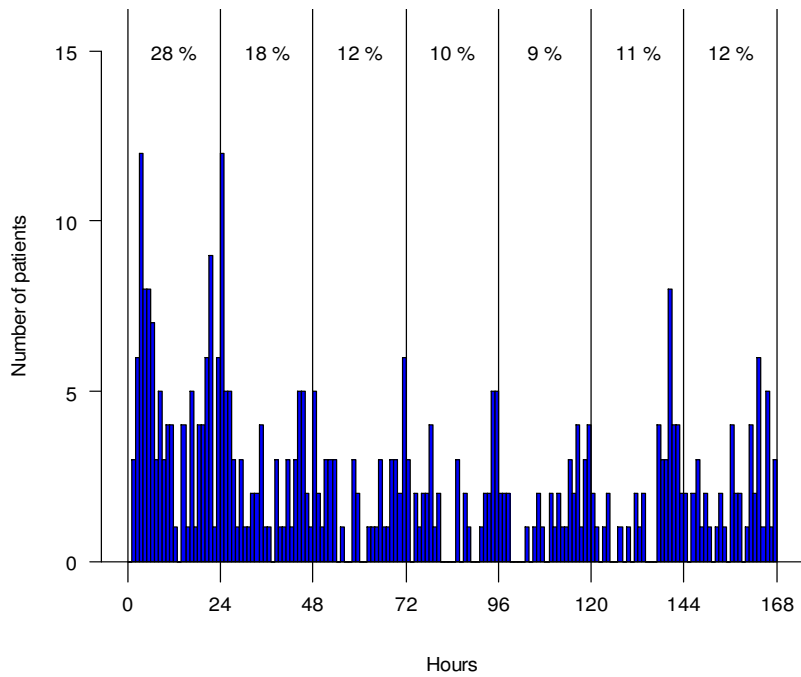
(Proportion of patients operated in 24 hour intervals)
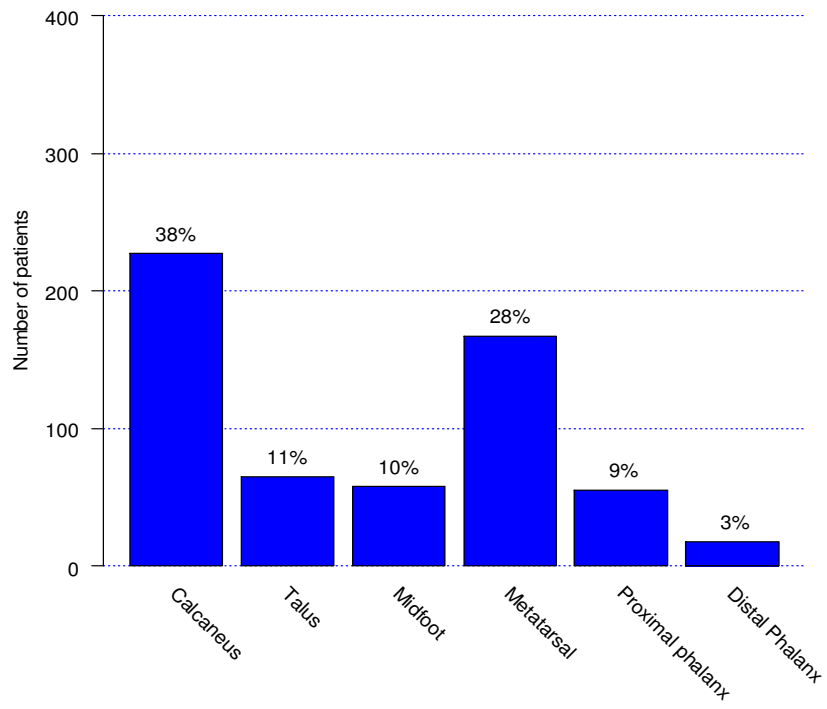
126

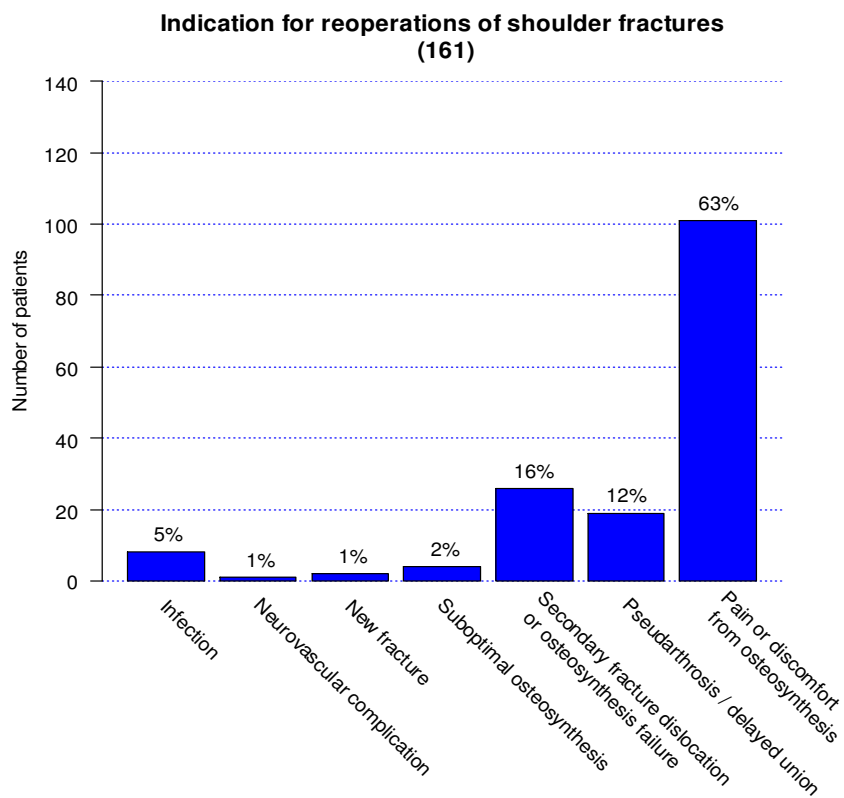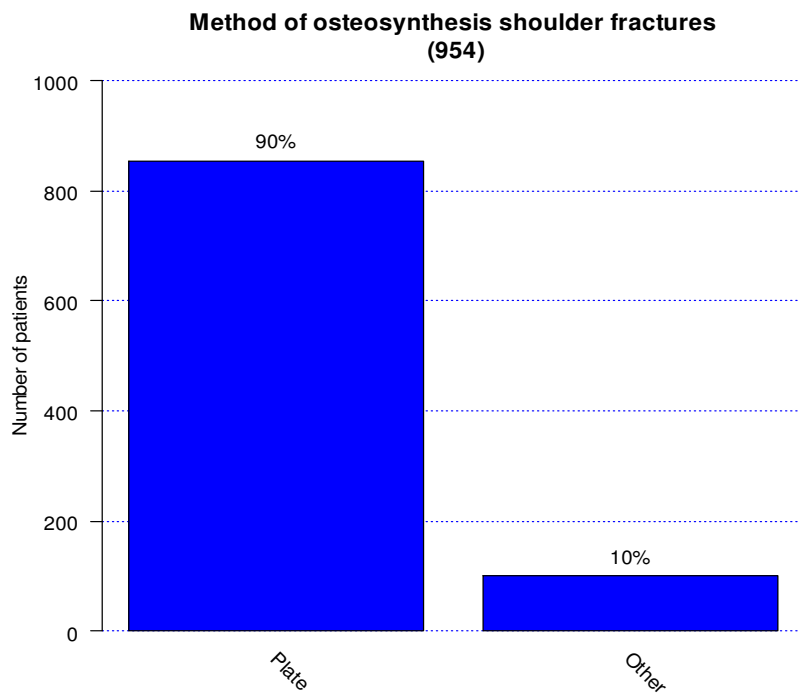**Survival for primary procedure with reoperation due to any reason**
foot fractures
(590)

Survival for primary procedure with reoperation due to any reason
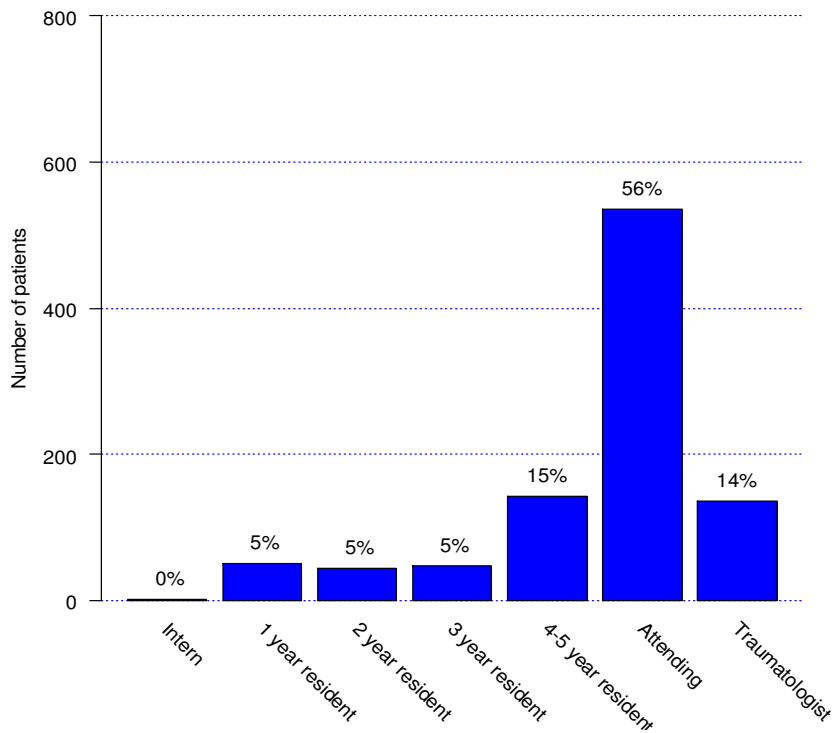**except pain and discomfort from surgical hardware**
foot fractures
(590)

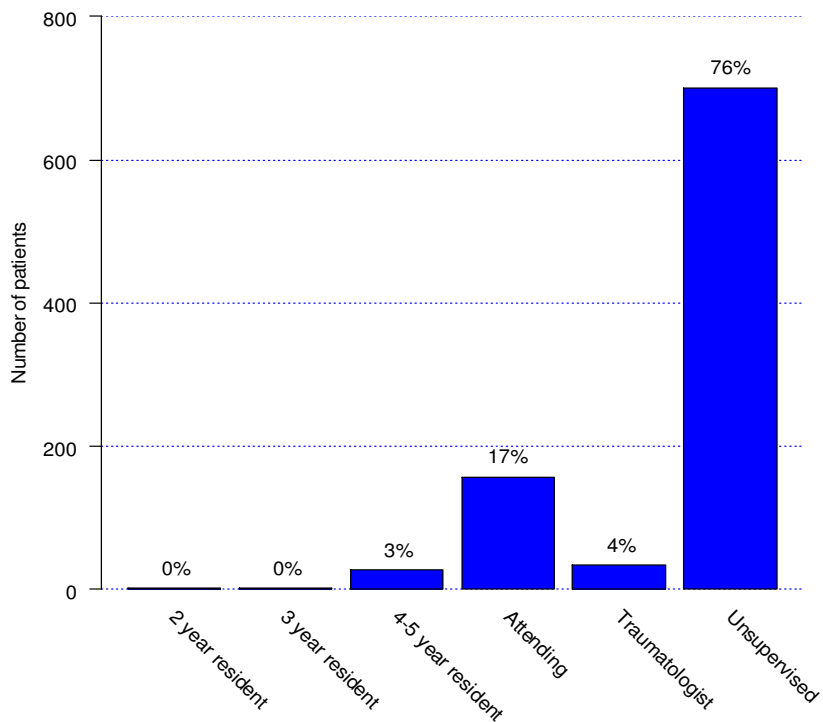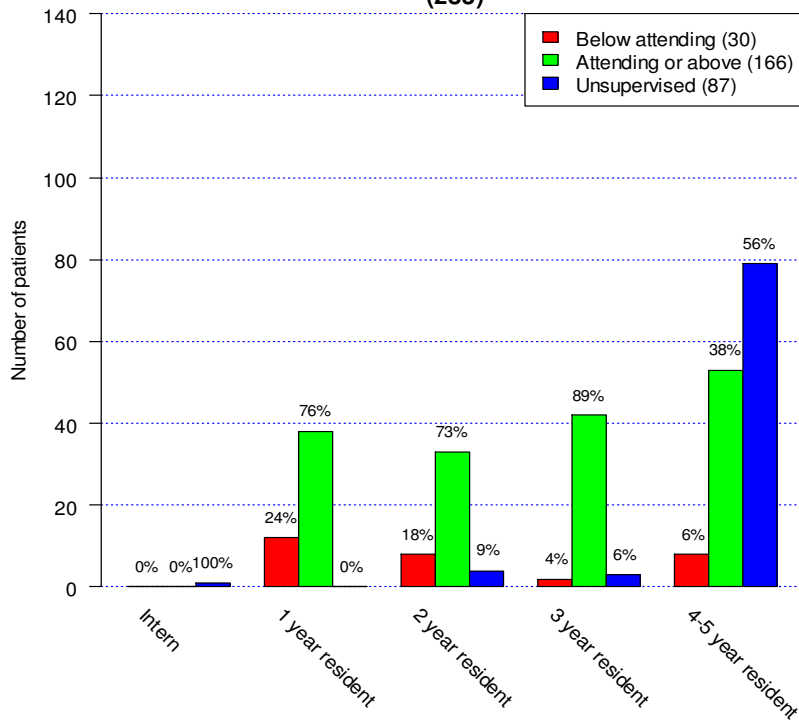**Fracture classification for foot fractures (590)**

Shoulder

**Method of osteosynthesis shoulder fractures
(954)**

**Indication for reoperations of shoulder fractures
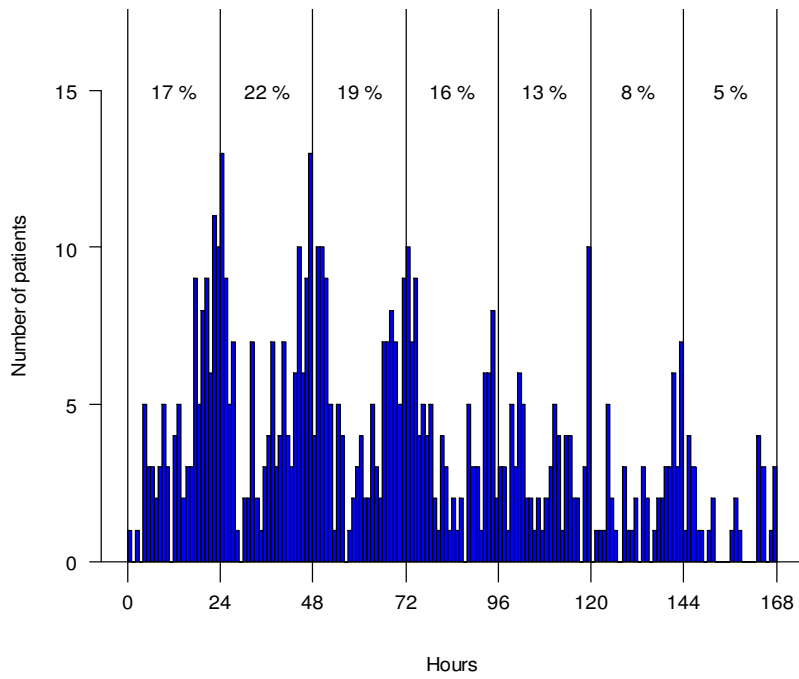(161)**

Surgeon level for shoulder fractures
(958)

Level of supervision for shoulder fractures
(922)

## Level of supervision for interns and residents shoulder fractures
(283)

Legend:
- Below attending (30) [red]
- Attending or above (166) [green]
- Unsupervised (87) [blue]

Y-axis: Number of patients

Category	Below attending	Attending or above	Unsupervised
Intern	0%	0%	100%
1 year resident	24%	76%	0%
2 year resident	18%	73%	9%
3 year resident	4%	89%	6%
4-5 year resident	6%	38%	56%

Surgical delay for shoulder fractures
(590)

17 % 22 % 19 % 16 % 13 % 8 % 5 %

Y-axis: Number of patients
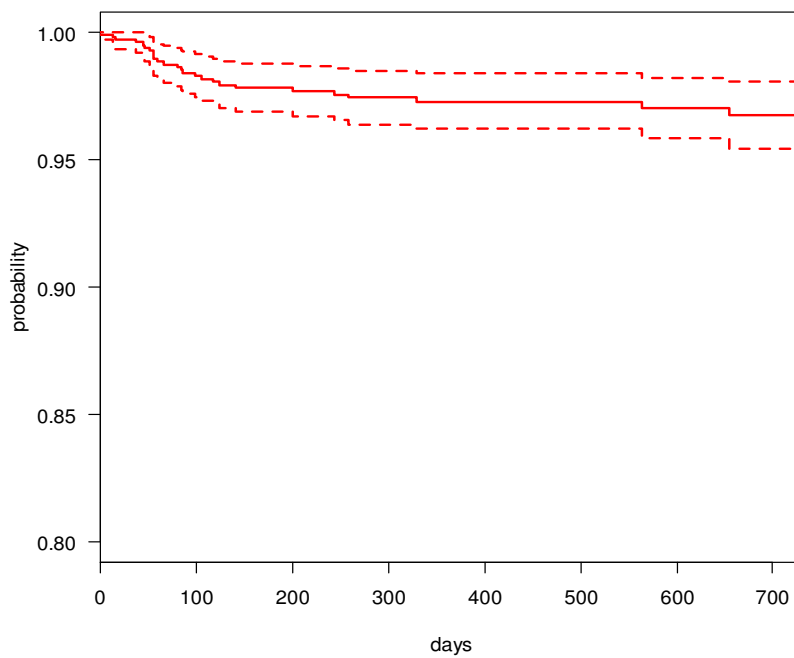
X-axis: Hours (0, 24, 48, 72, 96, 120, 144, 168)

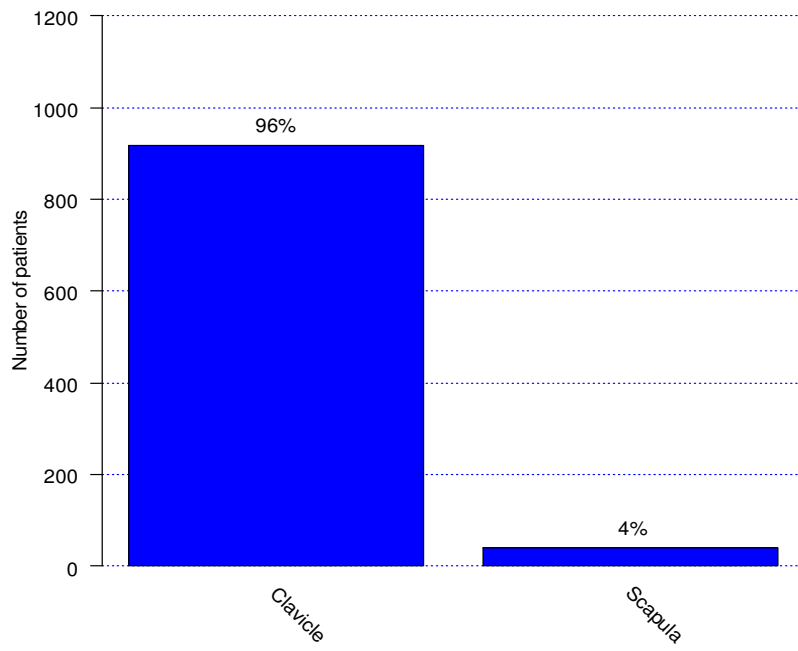(Proportion of patients operated in 24 hour intervals)

Survival for primary procedure with reoperation due to any reason
shoulder fractures
(958)
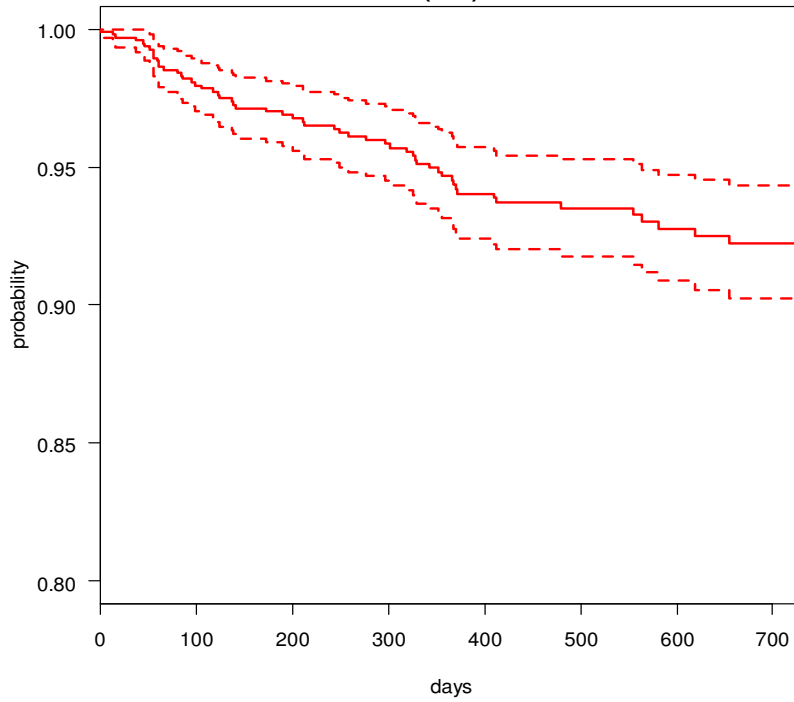
Survival for primary procedure with reoperation due to any reason
except pain and discomfort from surgical hardware
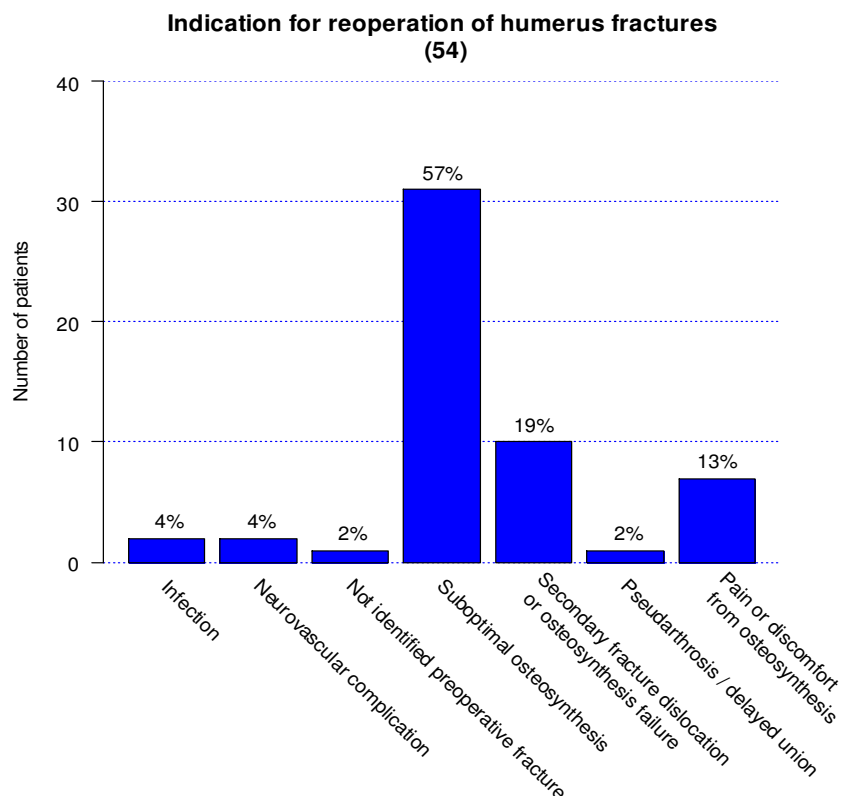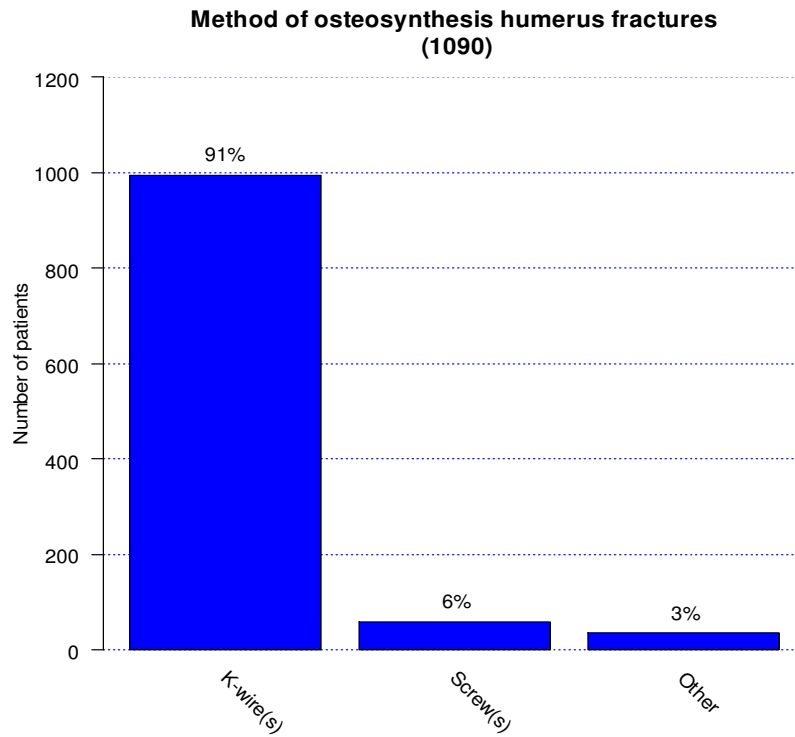### shoulder fractures
(958)

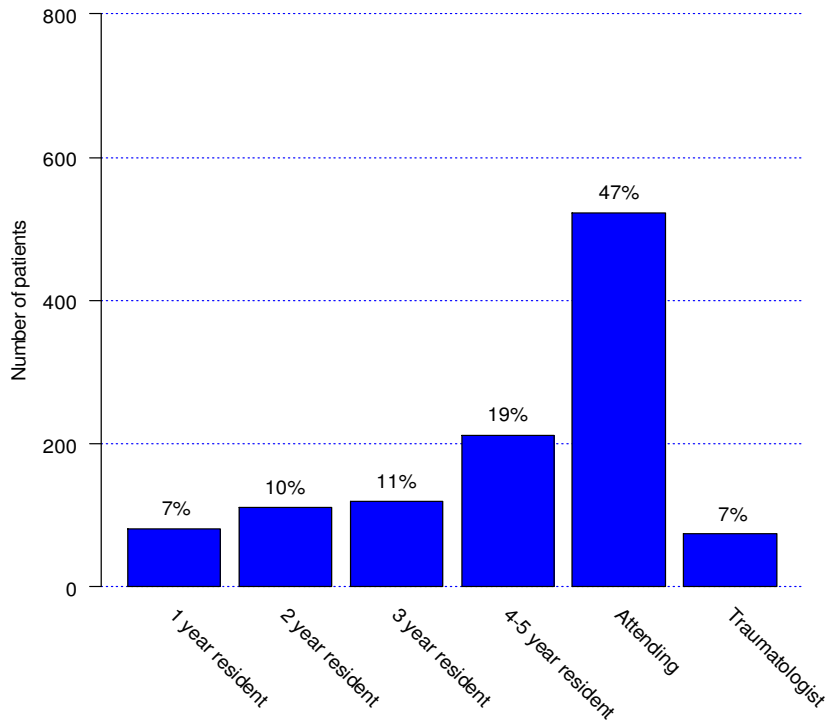**Fracture classification for shoulder fractures (958)**

Pediatric

Humerus

**Method of osteosynthesis humerus fractures
(1090)**

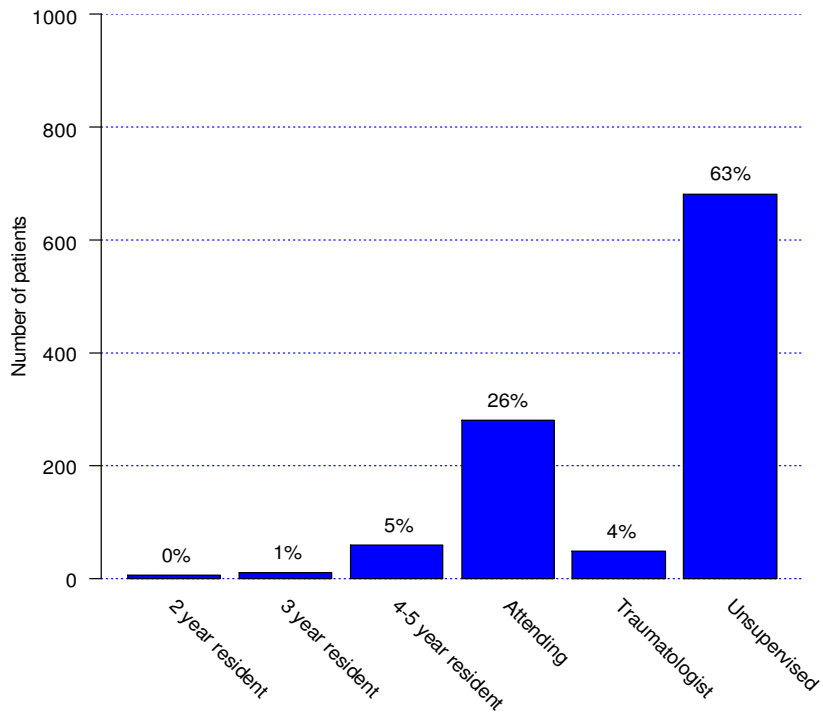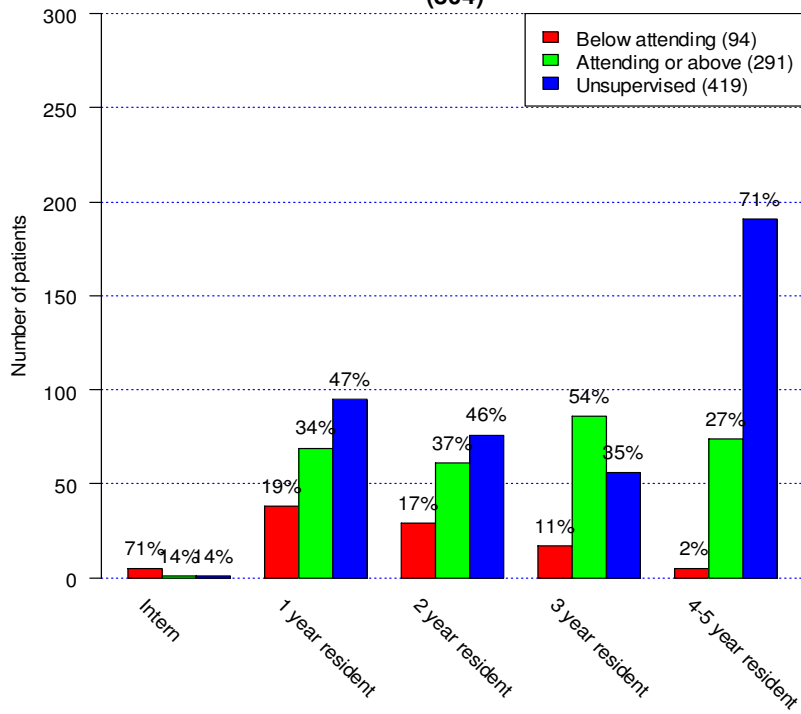**Indication for reoperation of humerus fractures
(54)**

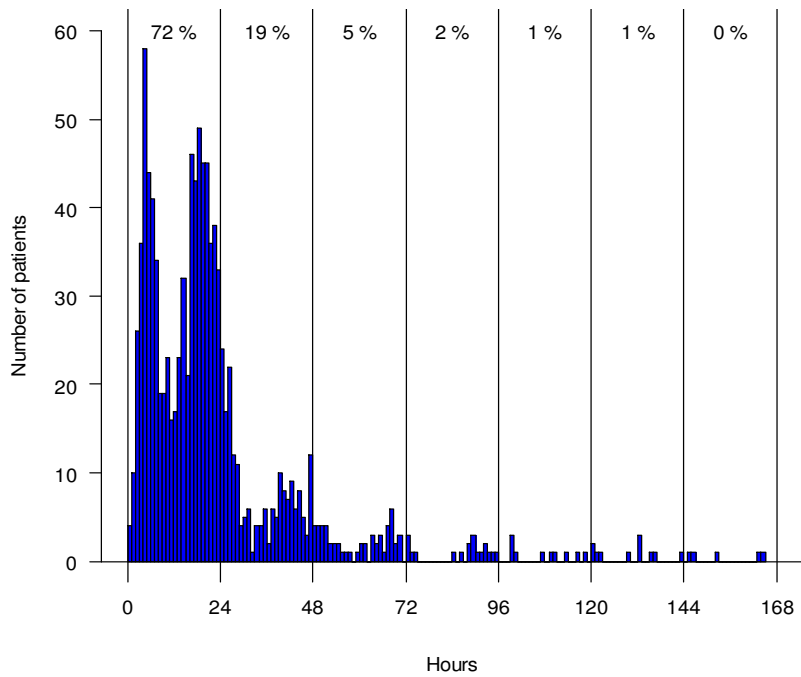## Surgeon level for humerus fractures
(1119)

Level of supervision for humerus fractures
(1085)

level of supervision for interns and residents
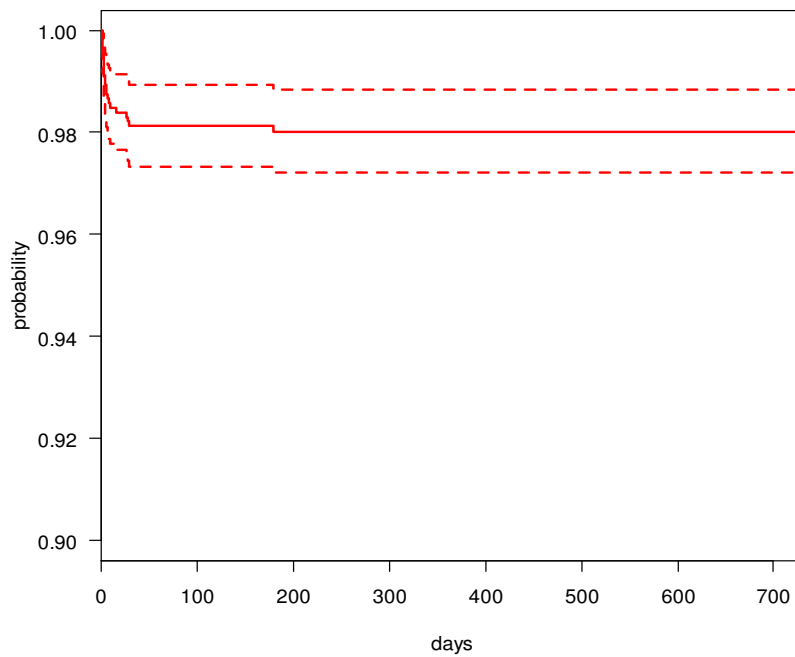## humerus fractures
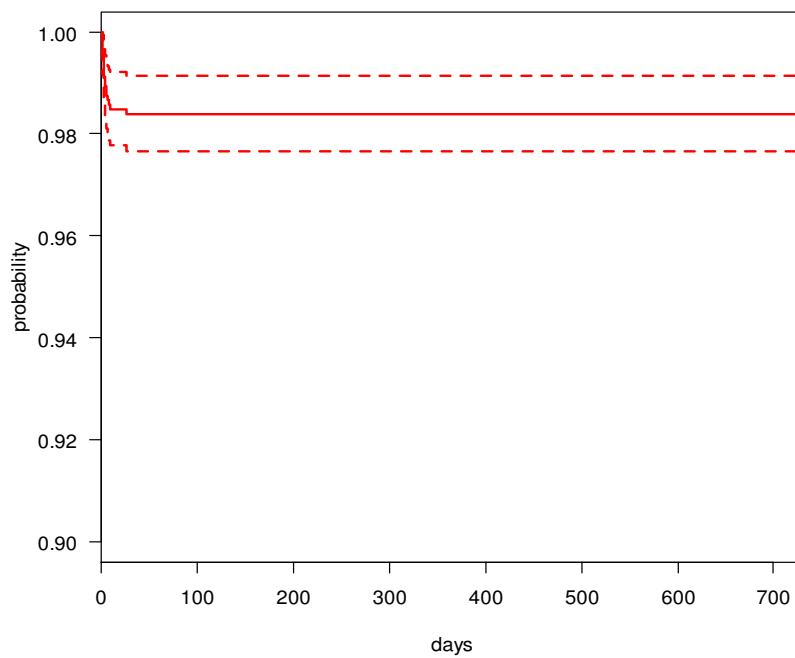## (804)

Surgical delay for humerus fractures
(1054)

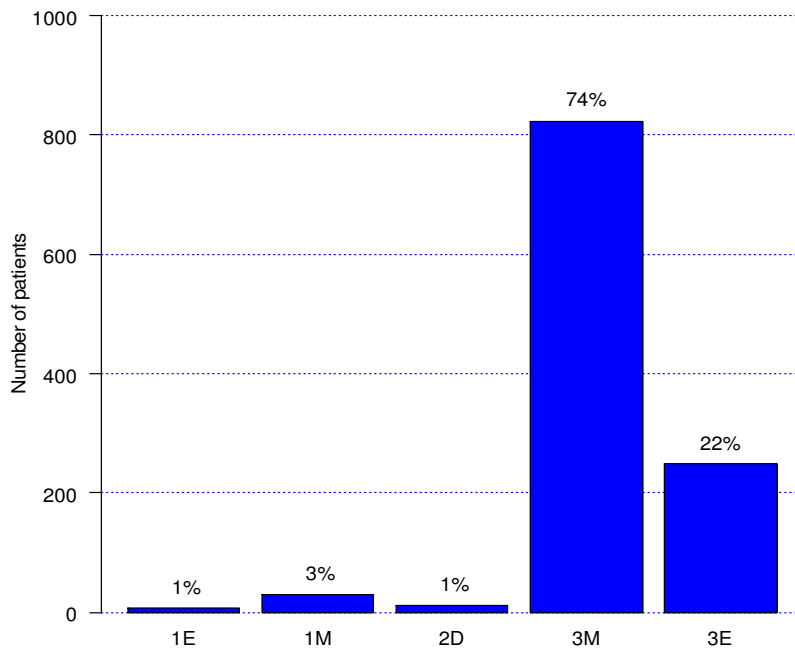(Proportion of patients operated in 24 hour intervals)

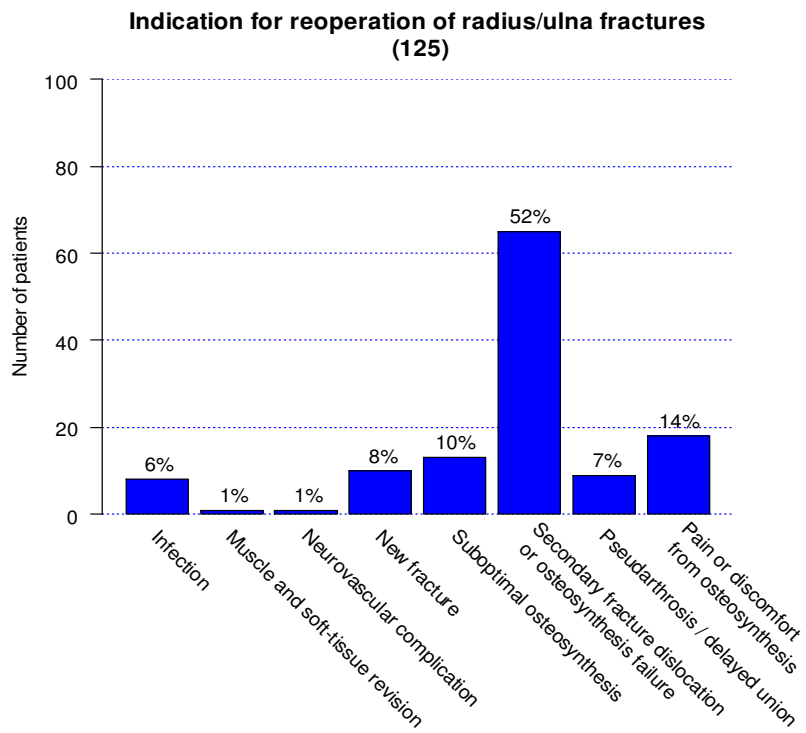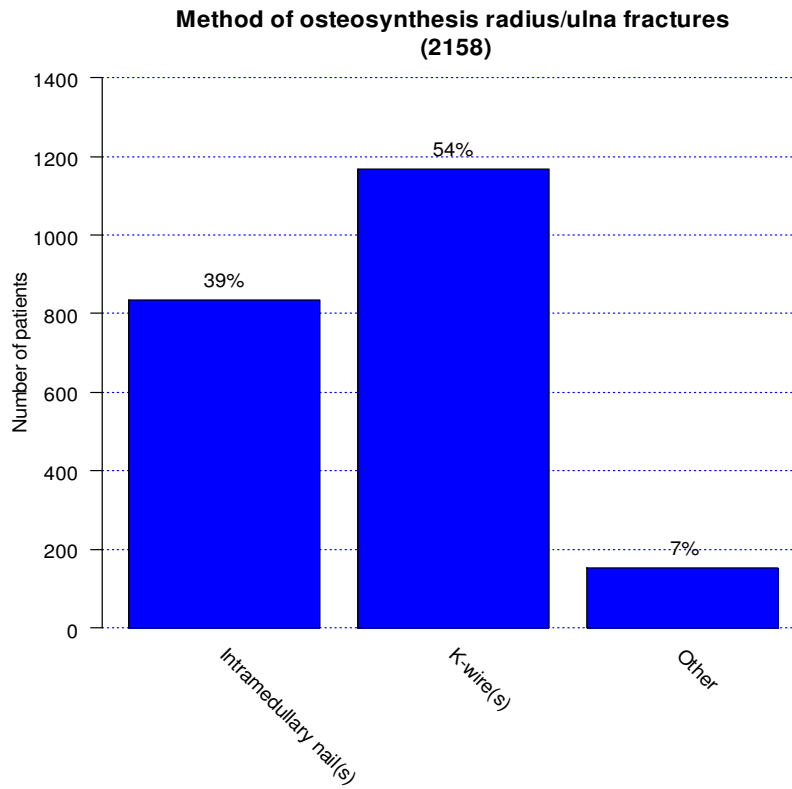## Survival for primary procedure with reoperation due to any reason
humerus fractures
(1120)

Survival for primary procedure with reoperation due to any reason
except pain and discomfort from surgical hardware
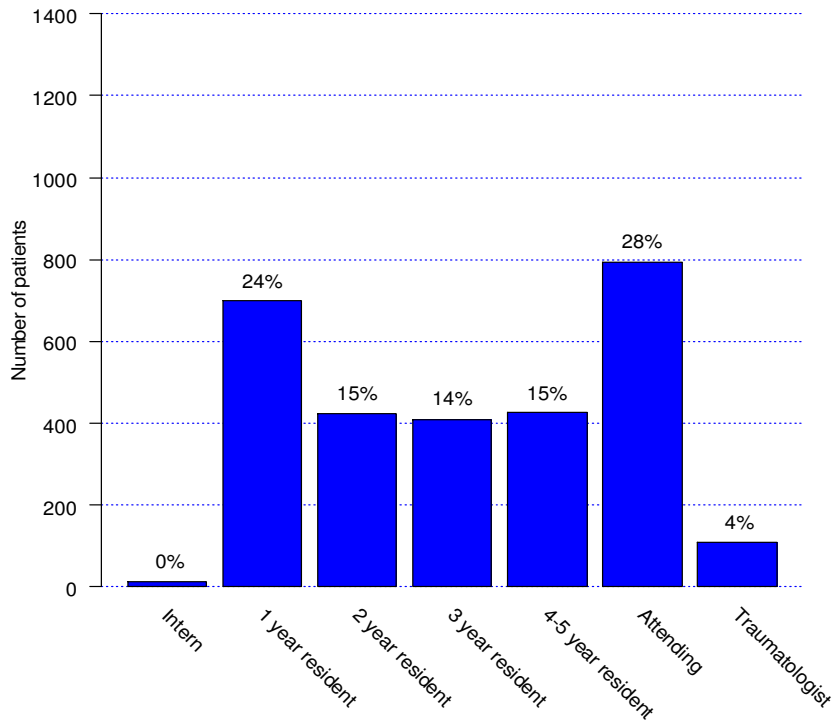## humerus fractures
## (1120)

Method distribution for humerus fractures
(1119)

Radius/Ulna

Method of osteosynthesis radius/ulna fractures (2158)

- Intramedullary nail(s): 39%
- K-wire(s): 54%
- Other: 7%

Y-axis: Number of patients

Indication for reoperation of radius/ulna fractures (125)

- Infection: 6%
- Muscle and soft-tissue revision: 1%
- Neurovascular complication: 1%
- New fracture: 8%
- Suboptimal osteosynthesis: 10%
- Secondary fracture dislocation or osteosynthesis failure: 52%
- Pseudarthrosis / delayed union: 7%
- Pain or discomfort from osteosynthesis: 14%

Y-axis: Number of patients
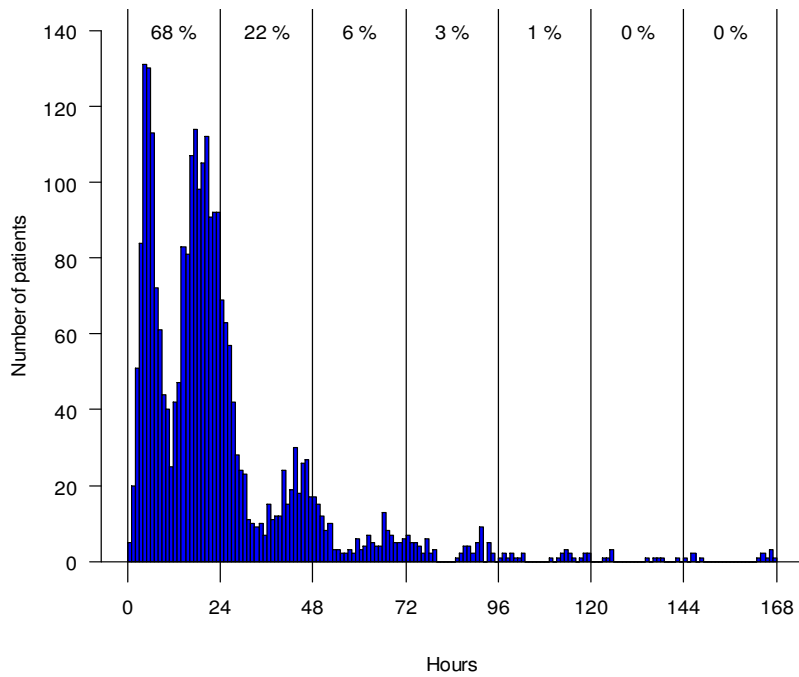
Surgeon level for radius/ulna fractures
(2874)

Level of supervision for radius/ulna fractures
(2798)
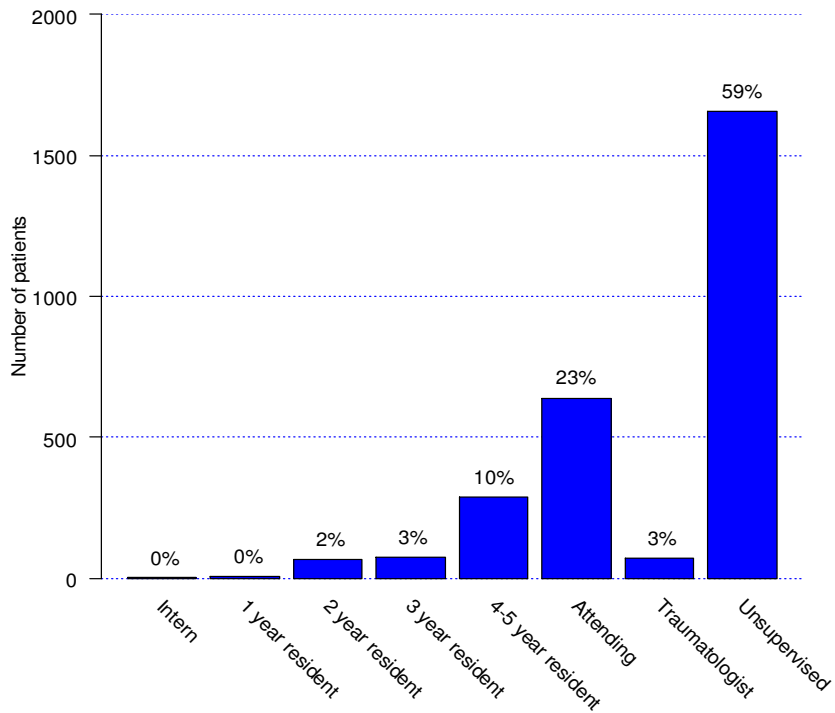
level of supervision for interns and residents radius/ulna fractures (2713)

Legend:
- Below attending (489)
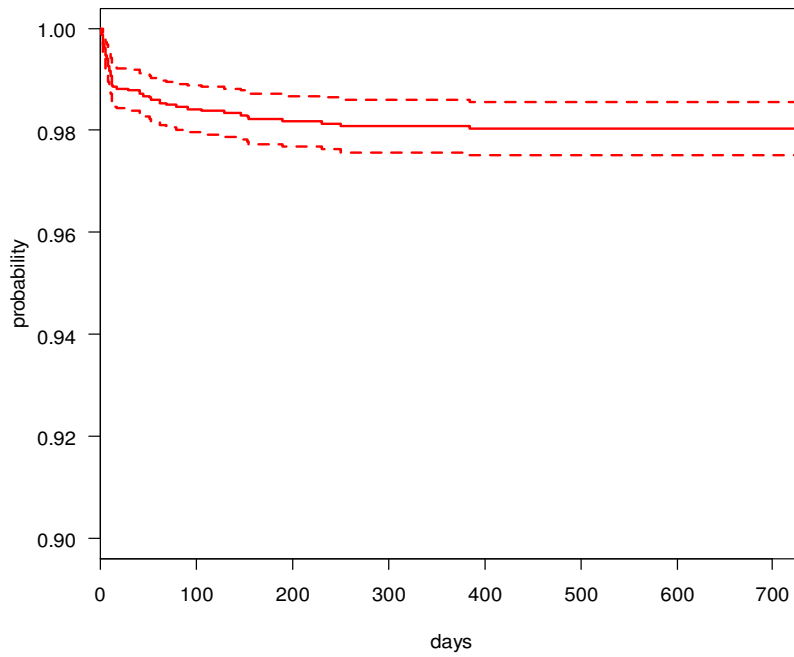- Attending or above (768)
- Unsupervised (1456)
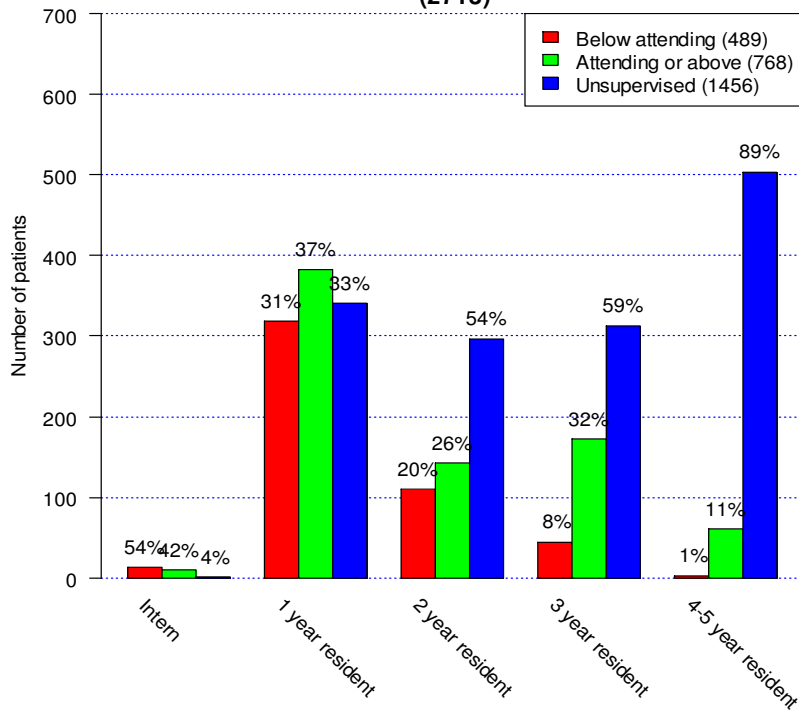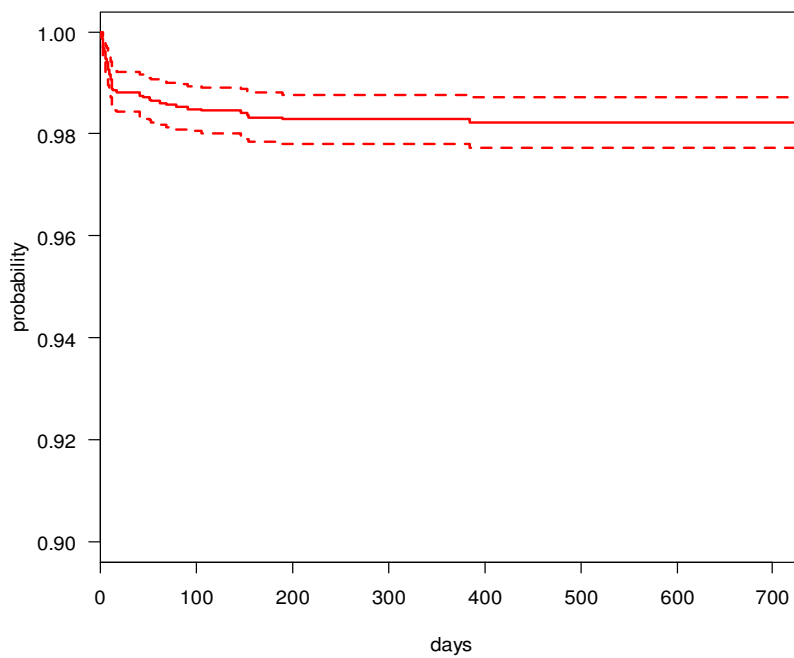
Surgical delay for radius/ulna fractures (2688)

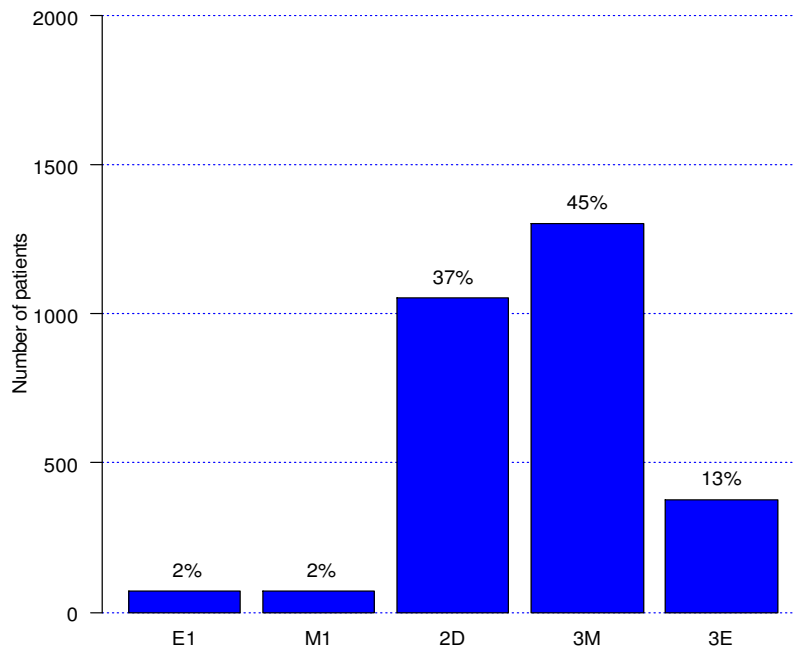(Proportion of patients operated in 24 hour intervals)

Survival for primary procedure with reoperation due to any reason
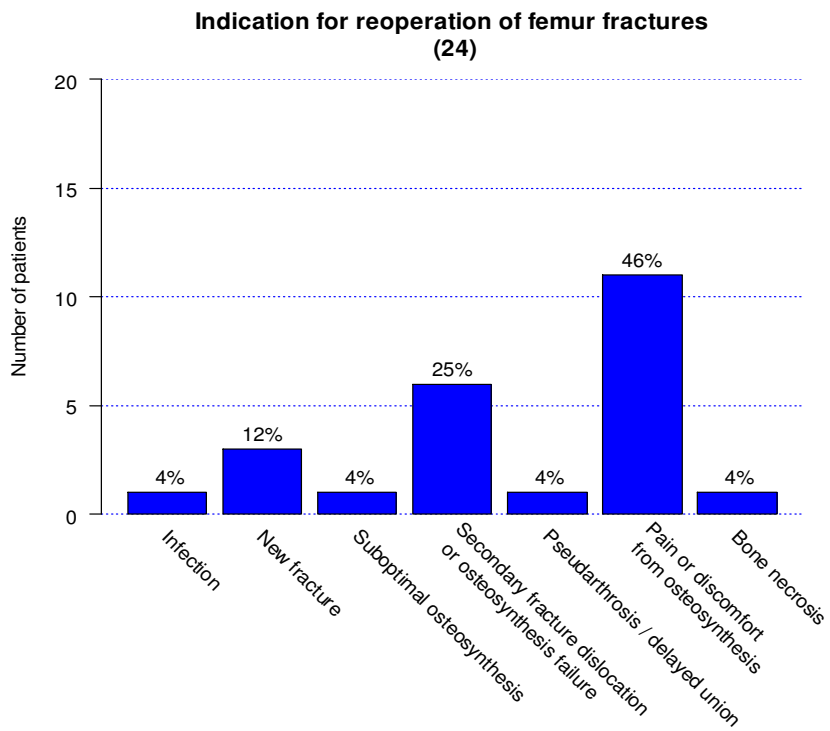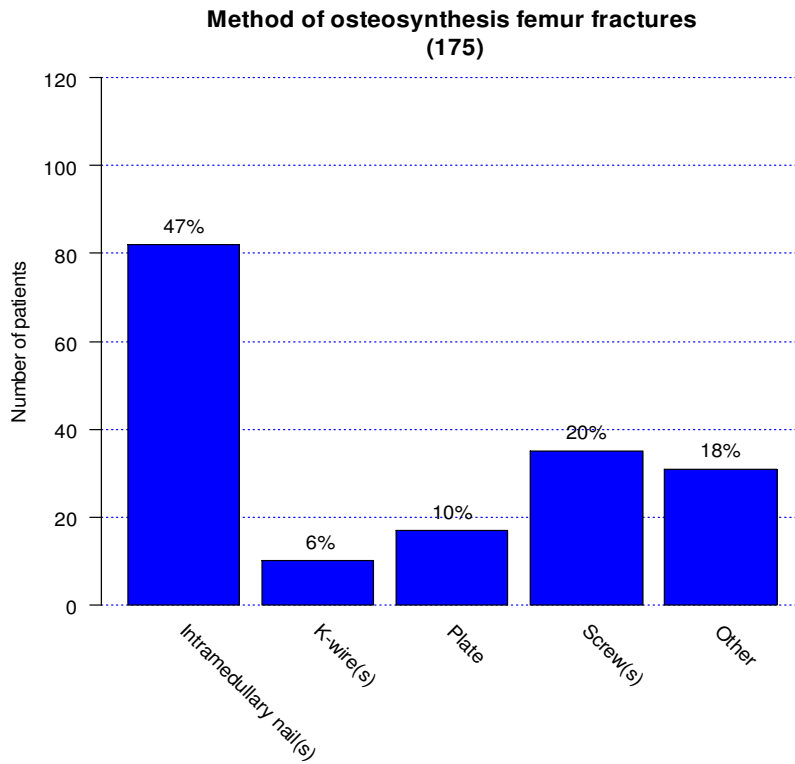**radius/ulna fractures**
(2875)

Survival for primary procedure with reoperation due to any reason
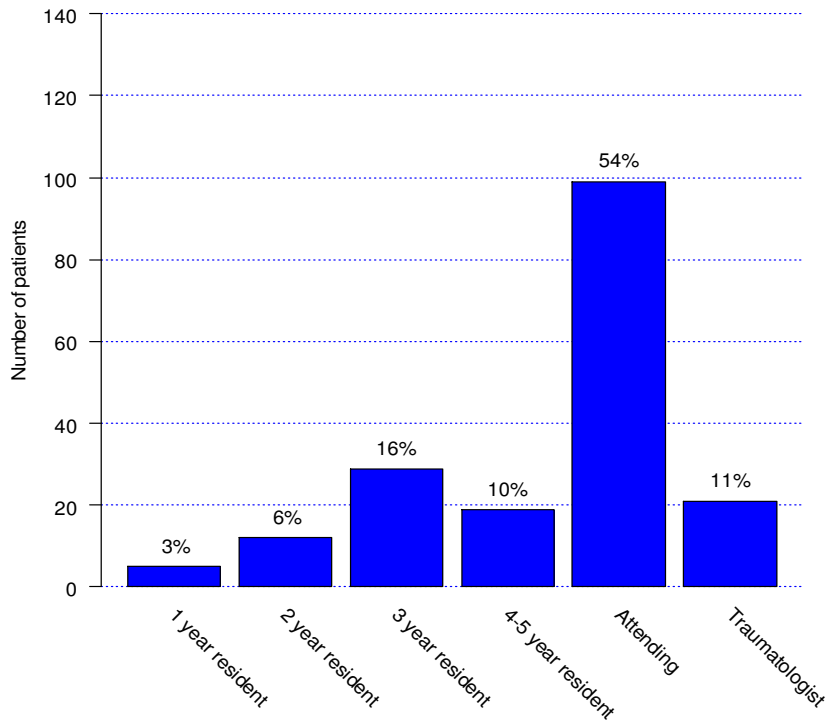**except pain and discomfort from surgical hardware**
radius/ulna fractures
(2875)

Method distribution for radius/ulna fractures (2876)

Femur

**Method of osteosynthesis femur fractures
(175)**

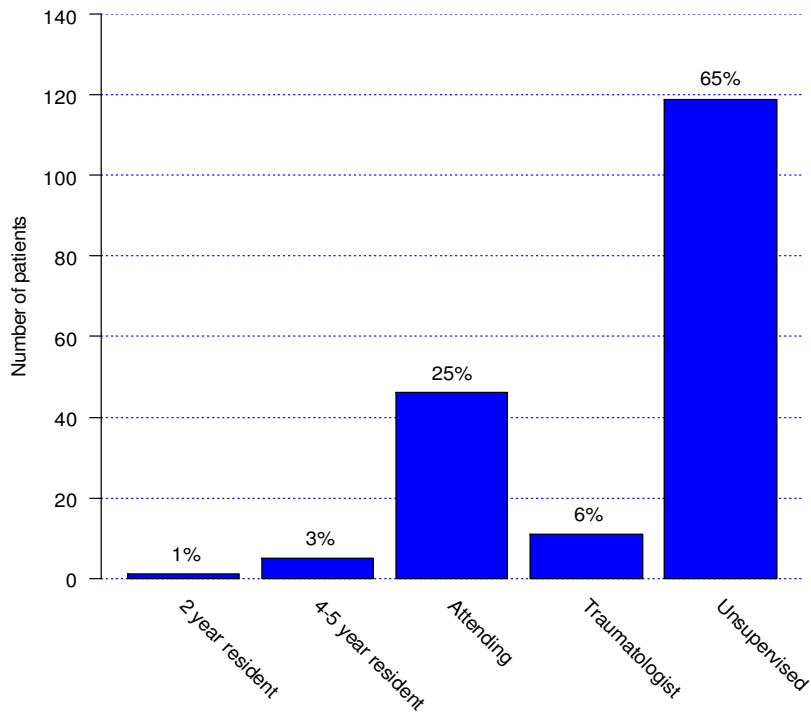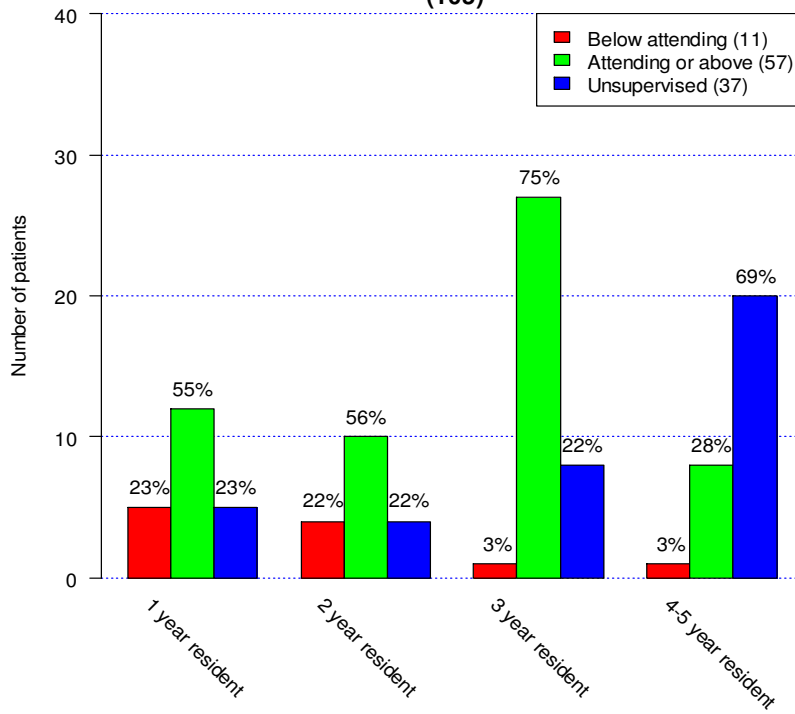**Indication for reoperation of femur fractures
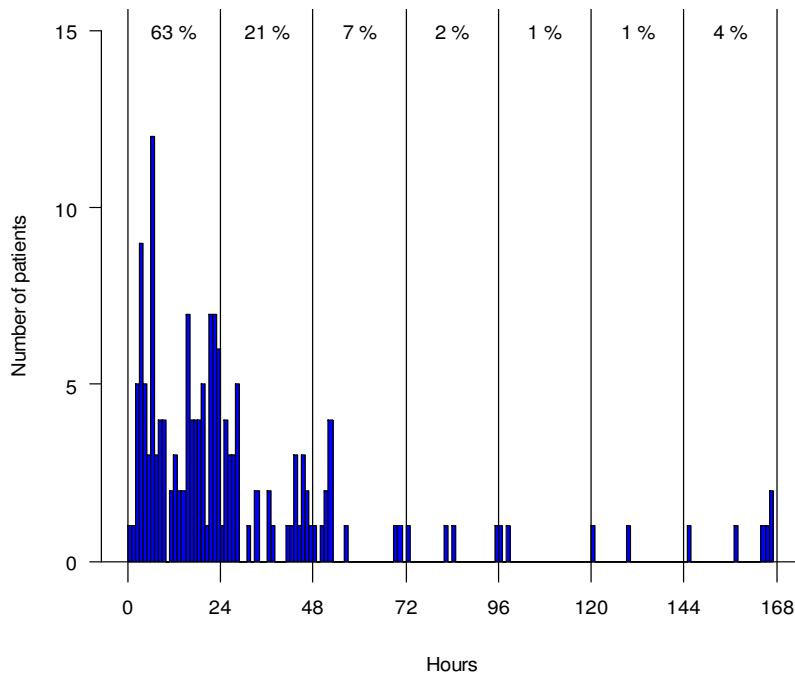(24)**

Surgeon level for femur fractures
(185)

Level of supervision for femur fractures
(182)

**level of supervision for interns and residents
femur fractures
(105)**

Legend:
- Below attending (11) — red
- Attending or above (57) — green
- Unsupervised (37) — blue

Y-axis: Number of patients

1 year resident: 23% / 55% / 23%
2 year resident: 22% / 56% / 22%
3 year resident: 3% / 75% / 22%
4-5 year resident: 3% / 28% / 69%

**Surgical delay for femur fractures
(160)**

Y-axis: Number of patients

63 %   21 %   7 %   2 %   1 %   1 %   4 %

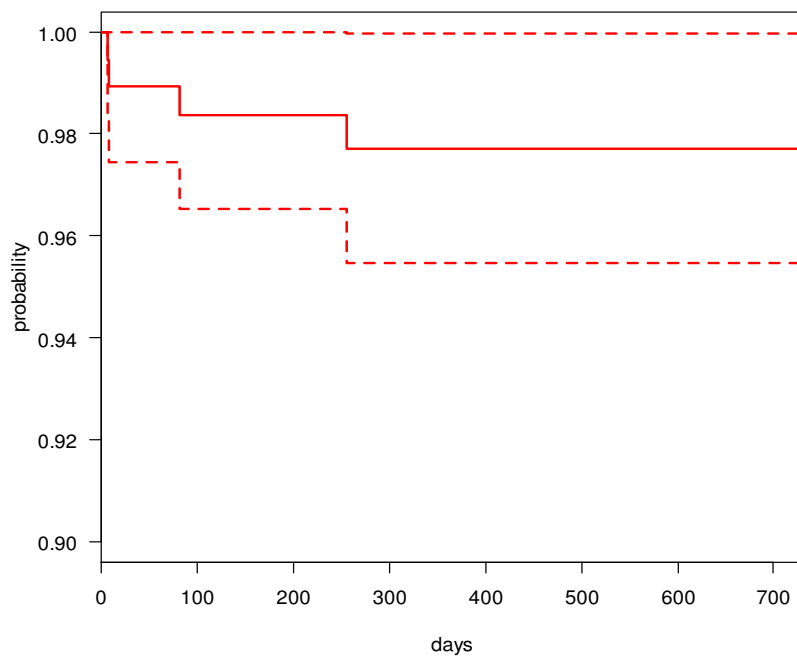X-axis: Hours (0, 24, 48, 72, 96, 120, 144, 168)

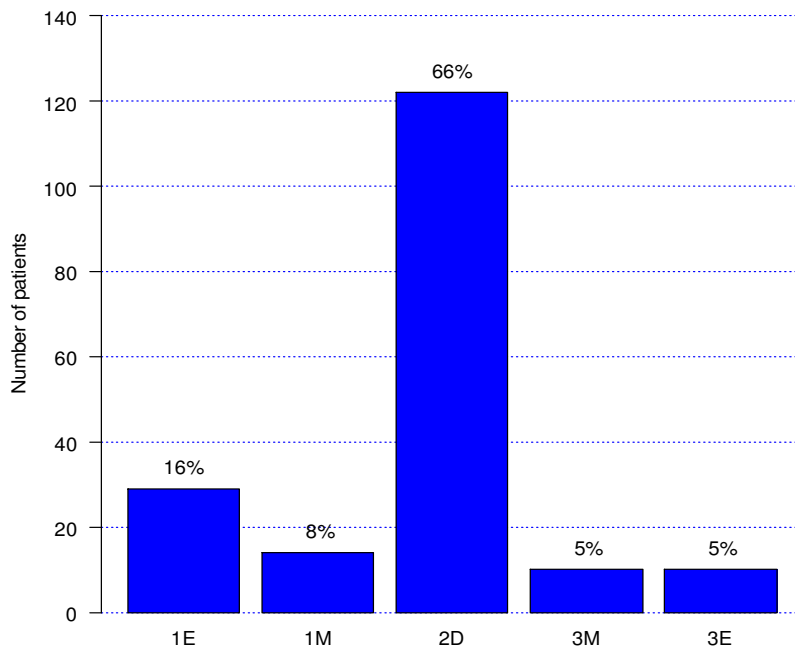(Proportion of patients operated in 24 hour intervals)

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Survival for primary procedure with reoperation due to any reason
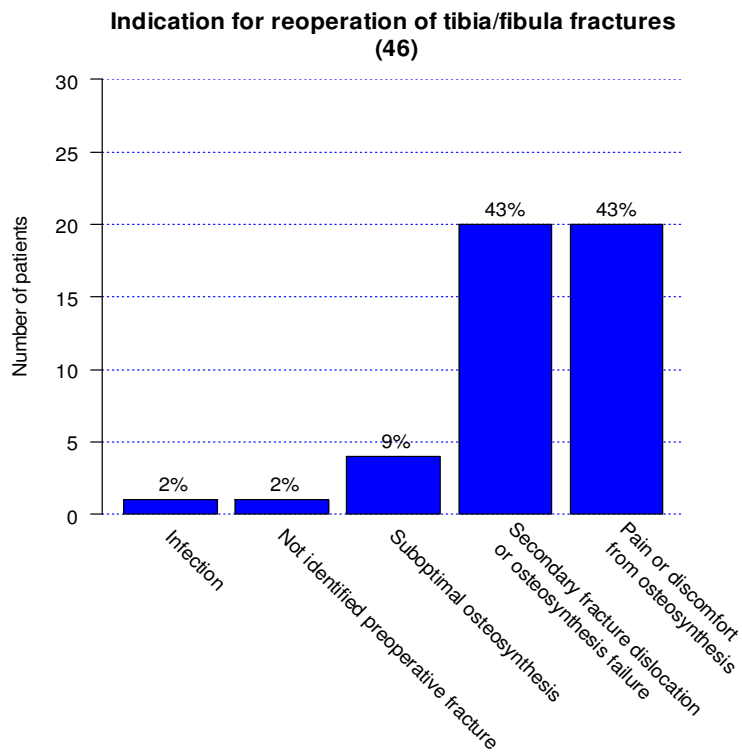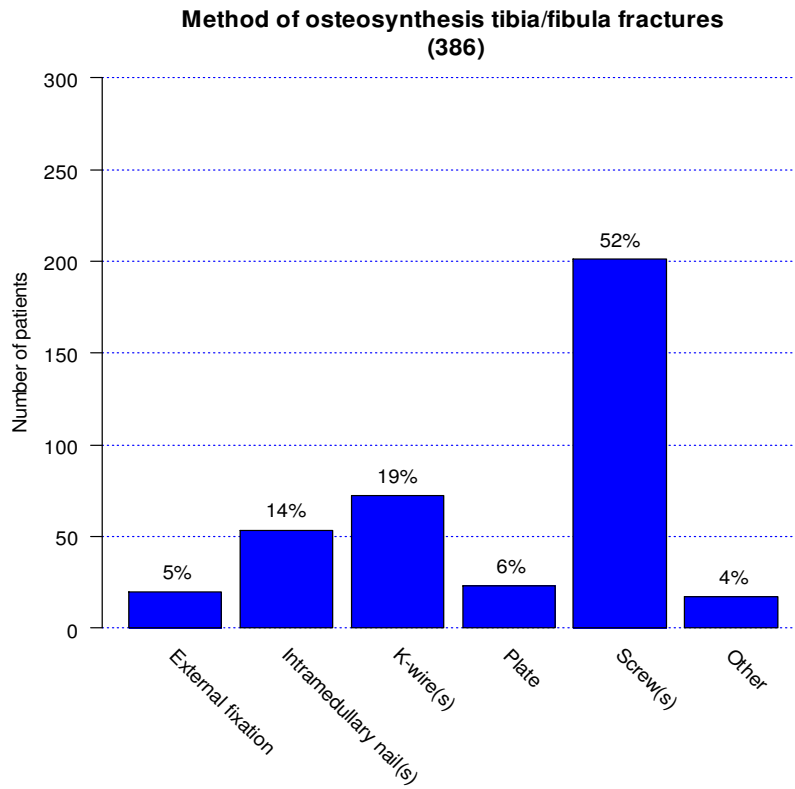## femur fractures
(185)
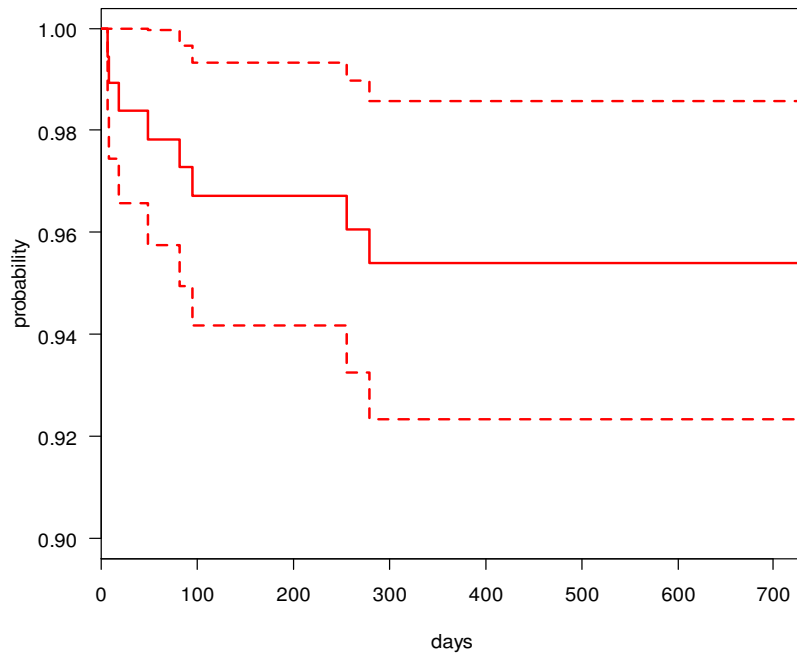
Survival for primary procedure with reoperation due to any reason
except pain and discomfort from surgical hardware
femur fractures
(185)

Method distribution for femur fractures
(185)

Tibia/fibula

**Method of osteosynthesis tibia/fibula fractures
(386)**

**Indication for reoperation of tibia/fibula fractures
(46)**

Surgeon level for tibia/fibula fractures
(468)

Level of supervision for tibia/fibula fractures
(453)

level of supervision for interns and residents
tibia/fibula fractures
(356)

Legend:
- Below attending (40)
- Attending or above (149)
- Unsupervised (167)

Surgical delay for tibia/fibula fractures
(429)

(Proportion of patients operated in 24 hour intervals)

Survival for primary procedure with reoperation due to any reason
tibia/fibula fractures
(468)

Survival for primary procedure with reoperation due to any reason
except pain and discomfort from surgical hardware
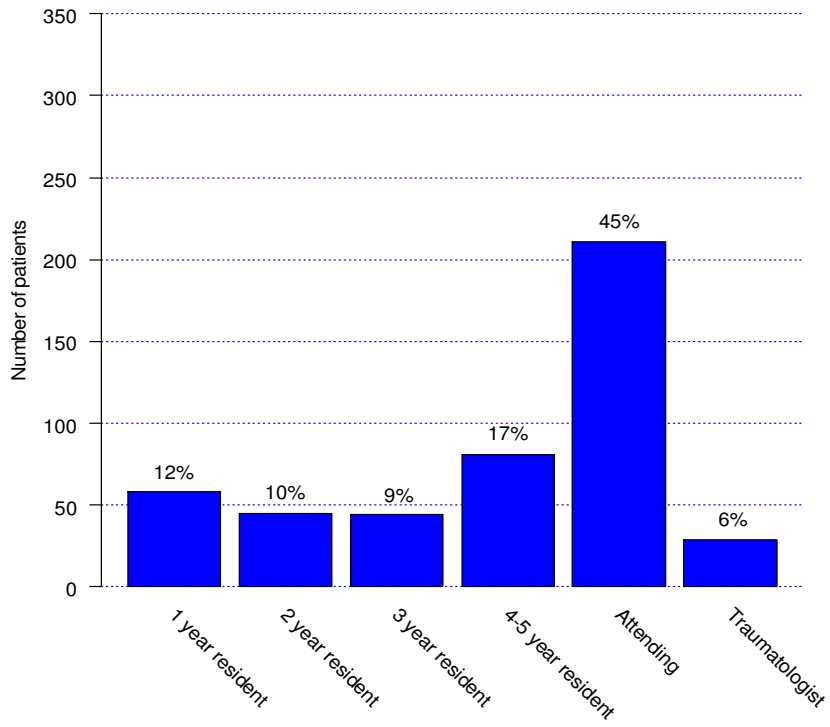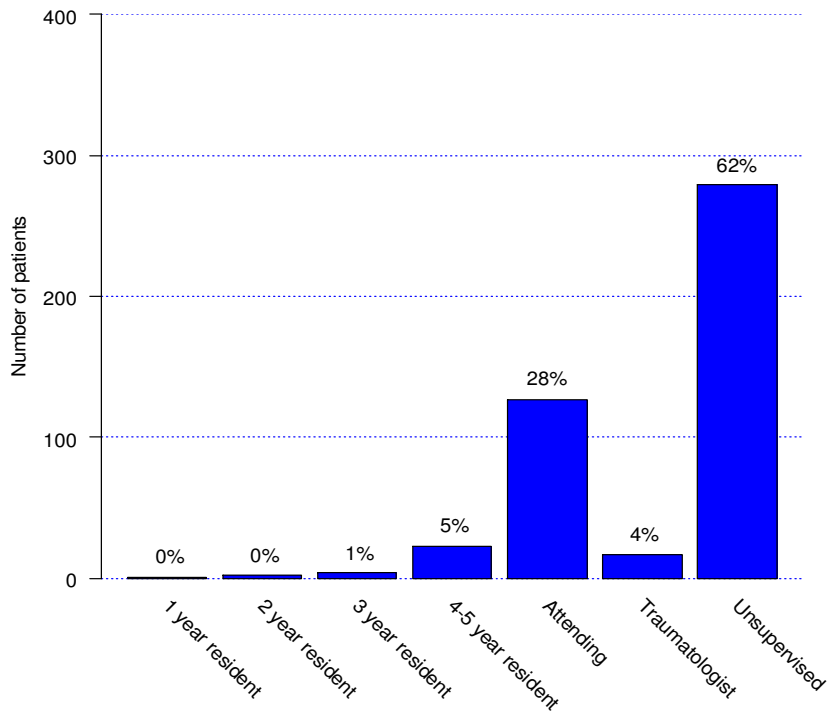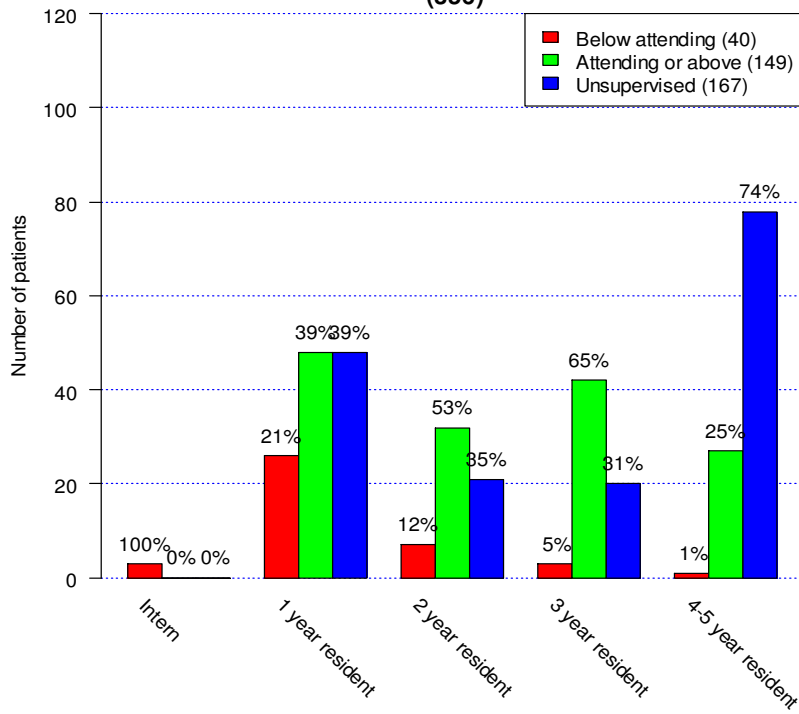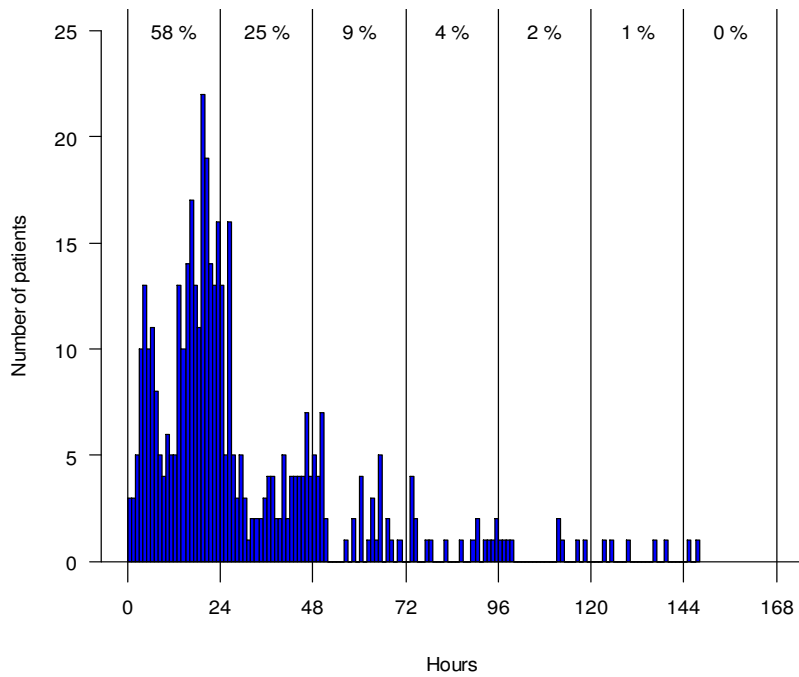### tibia/fibula fractures
(468)

Method distribution for tibia/fibula fractures
(468)

Hand

Method of osteosynthesis hand fractures
(229)

Indication for reoperation of hand fractures
(12)

Surgeon level for hand fractures
(288)
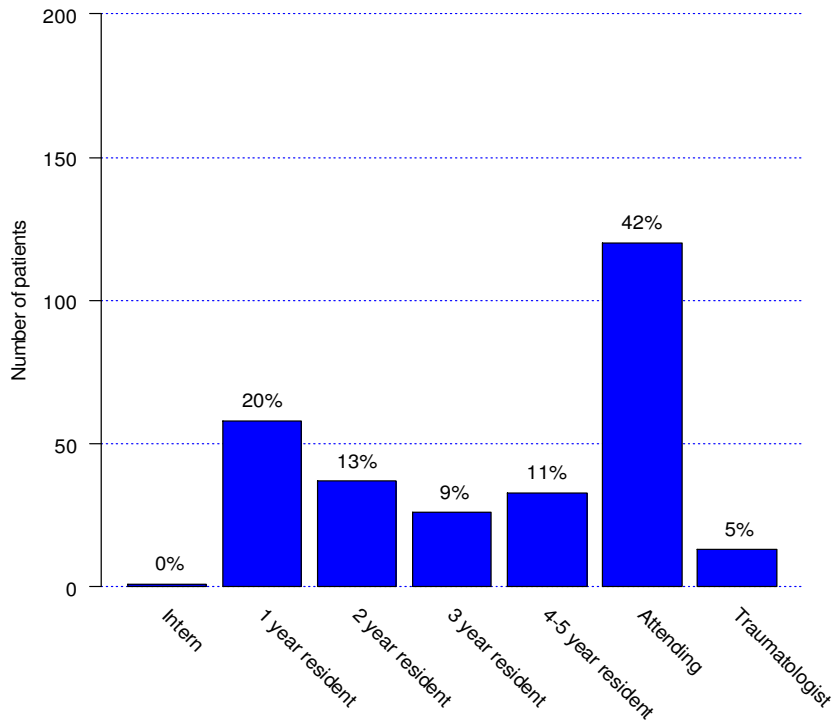
Level of supervision for hand fractures
(278)
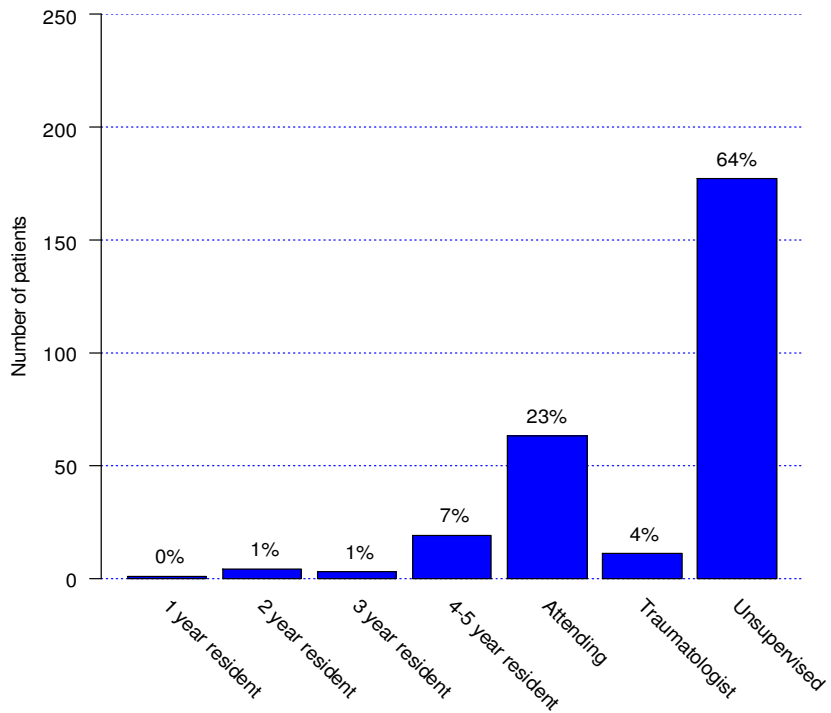
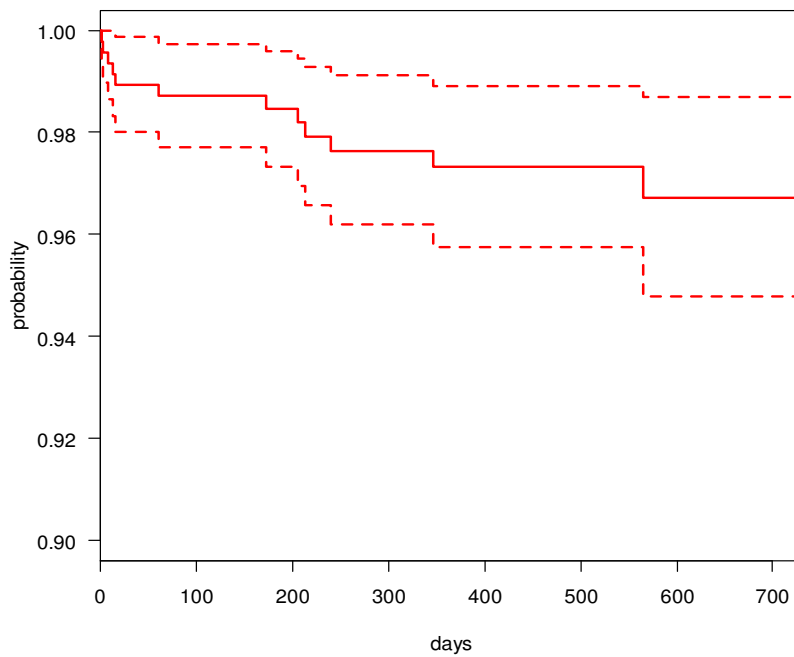## level of supervision for interns and residents
hand fractures
(188)
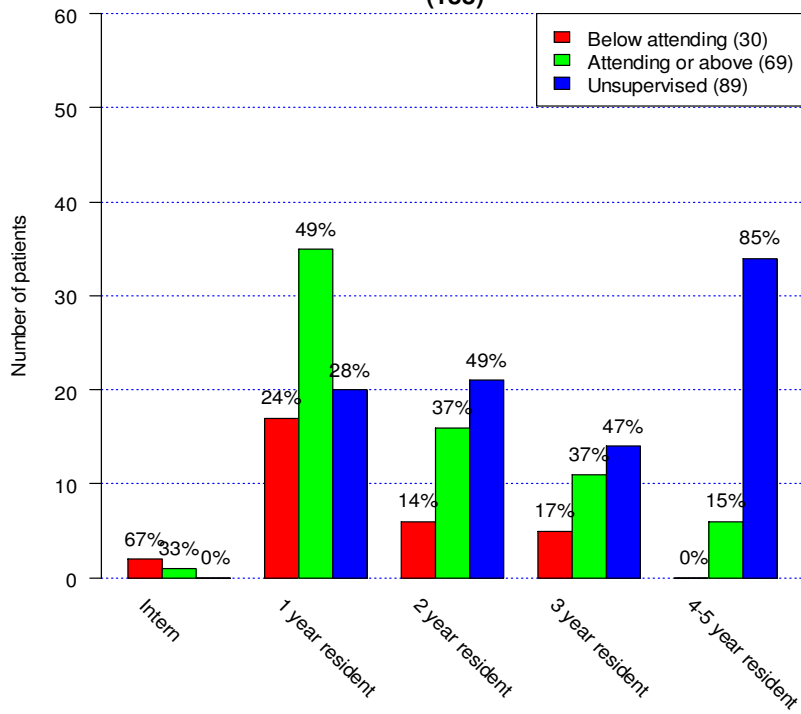
Surgical delay for hand fractures
(256)
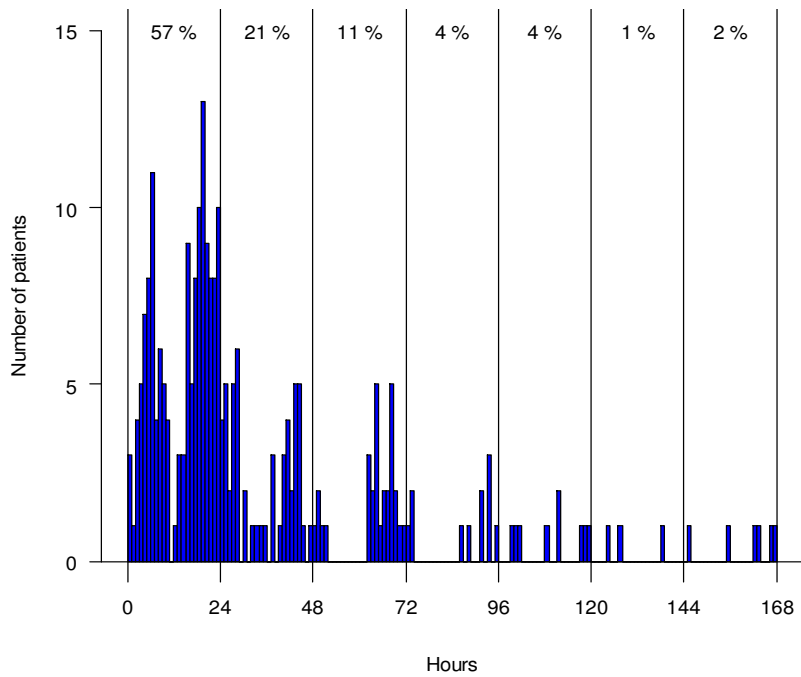
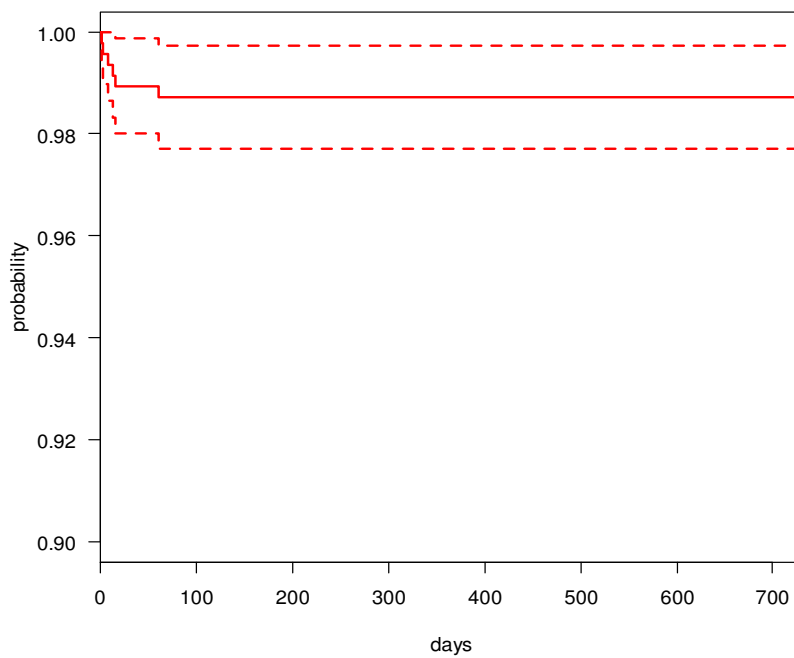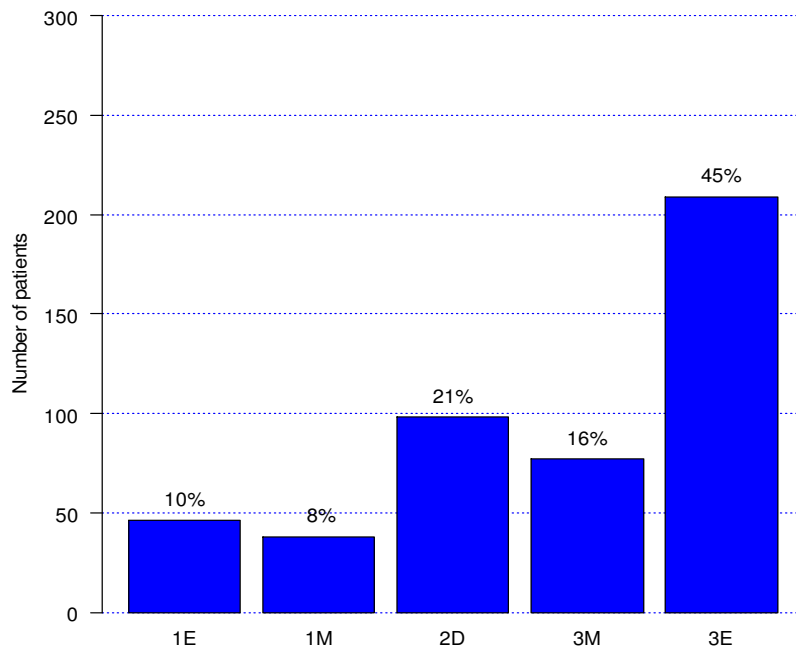
(Proportion of patients operated in 24 hour intervals)

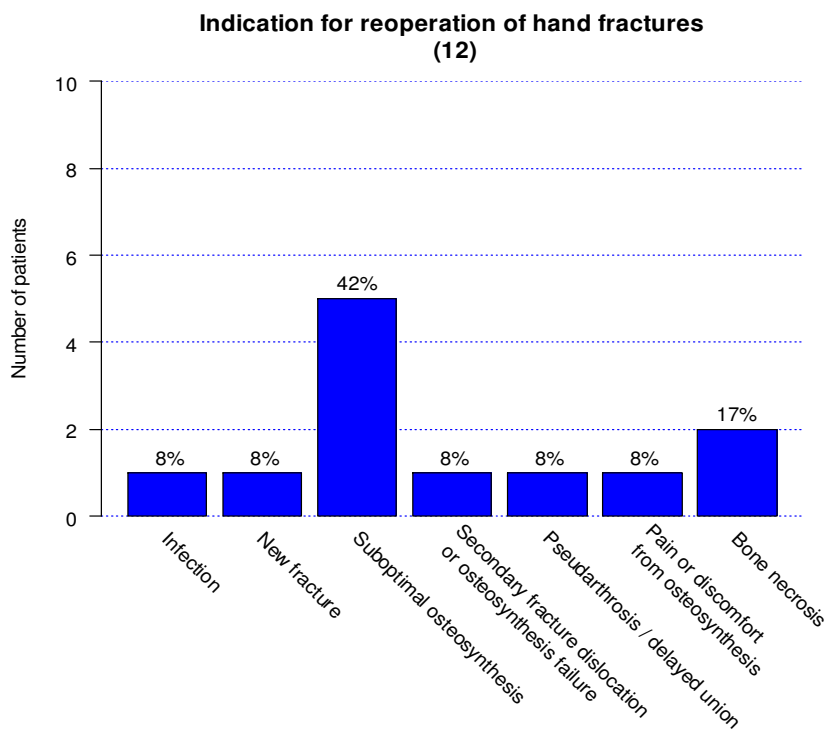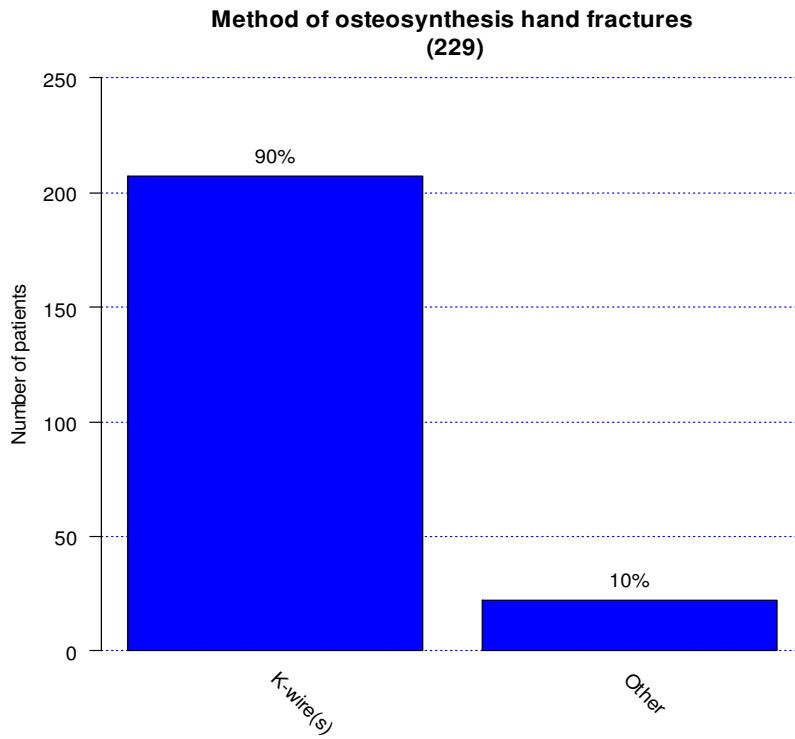**Survival for primary procedure with reoperation due to any reason hand fractures (290)**

Survival for primary procedure with reoperation due to any reason except pain and discomfort from surgical hardware hand fractures (290)

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Foot

Method of osteosynthesis foot fractures
(42)

Indication for reoperation of foot fractures
(1)

Surgeon level for foot fractures
(45)

Level of supervision for foot fractures
(45)

level of supervision for interns and residents
foot fractures
(26)

Surgical delay for foot fractures
(39)
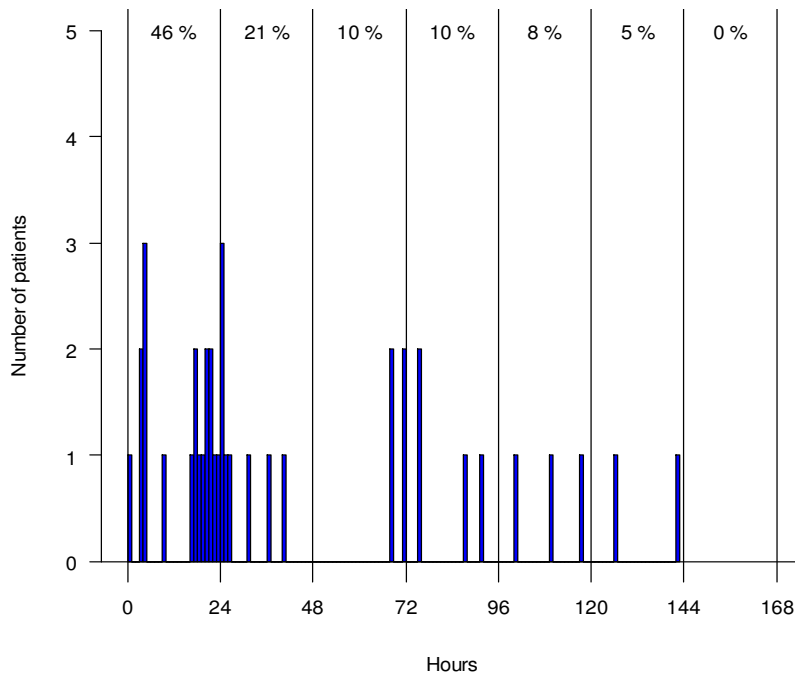
(Proportion of patients operated in 24 hour intervals)

Survival for primary procedure with reoperation due to any reason
foot fractures
(45)

Survival for primary procedure with reoperation due to any reason
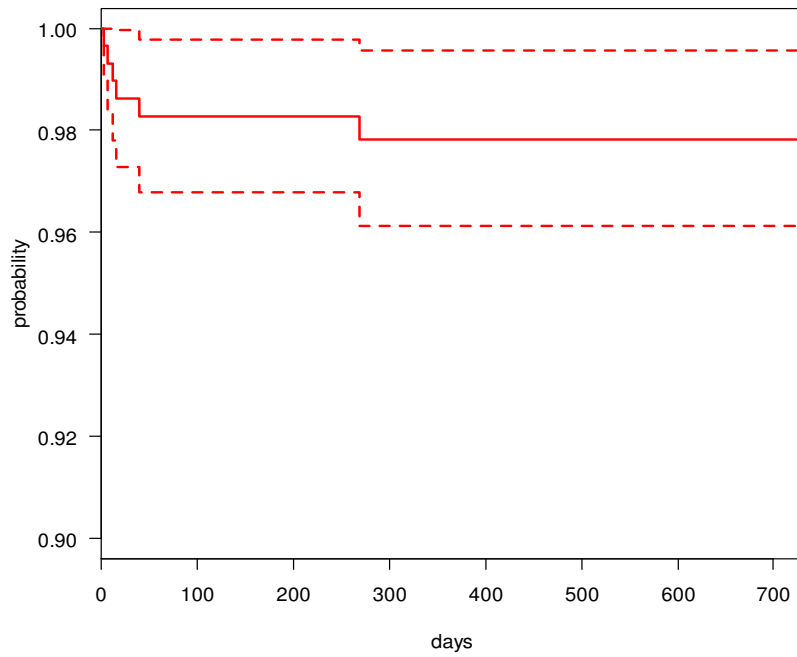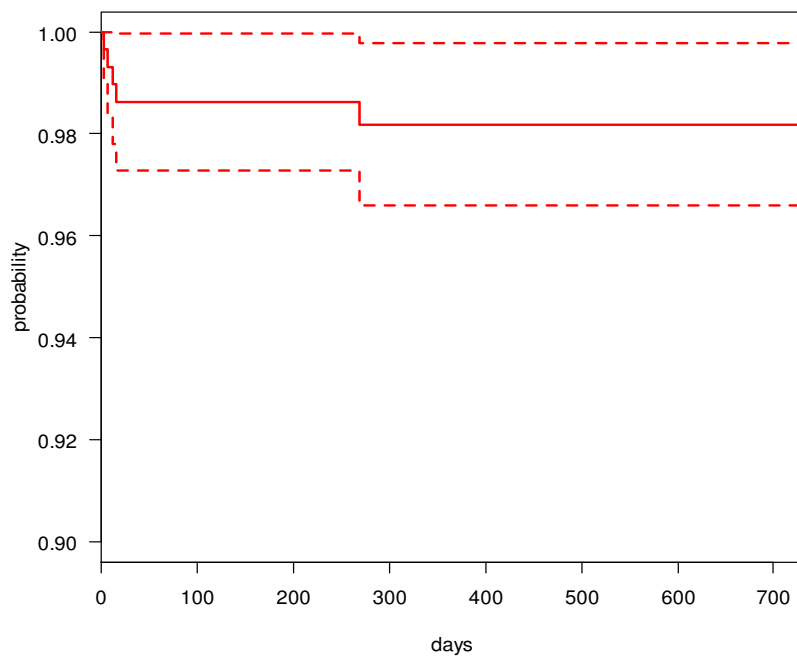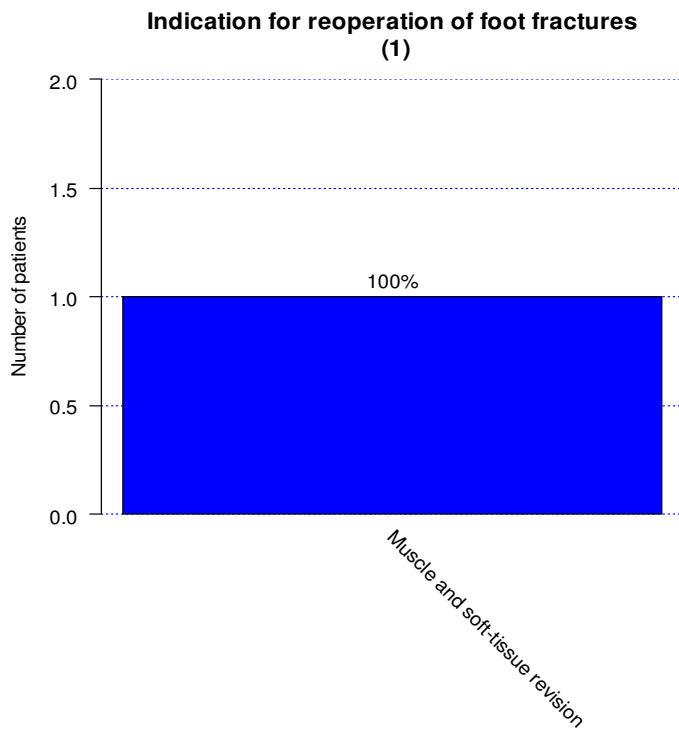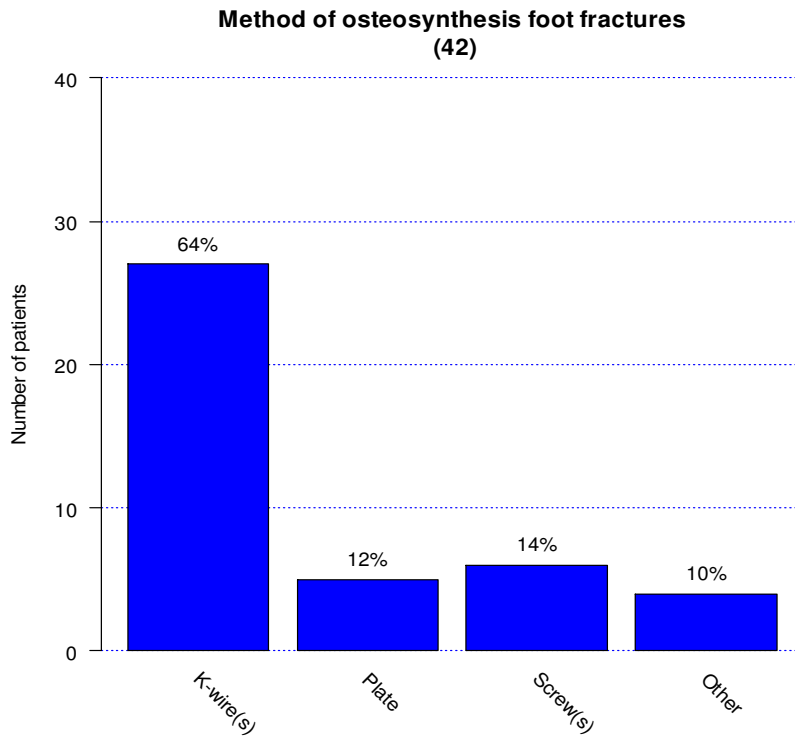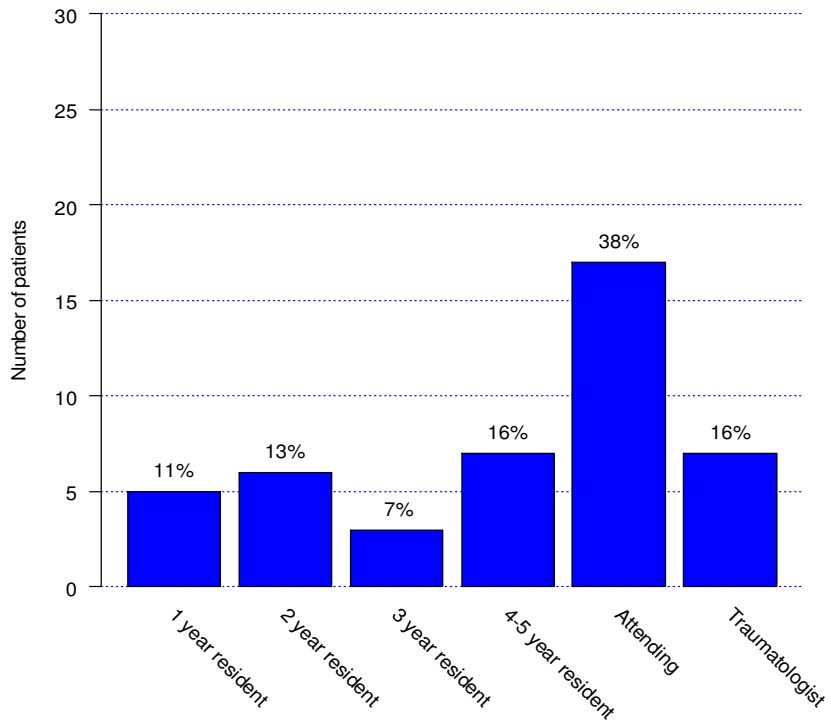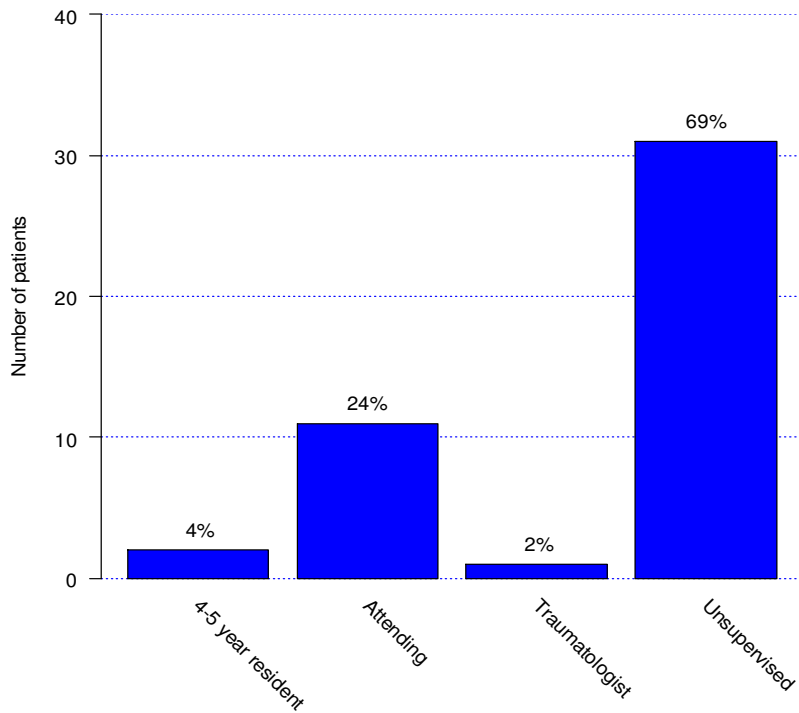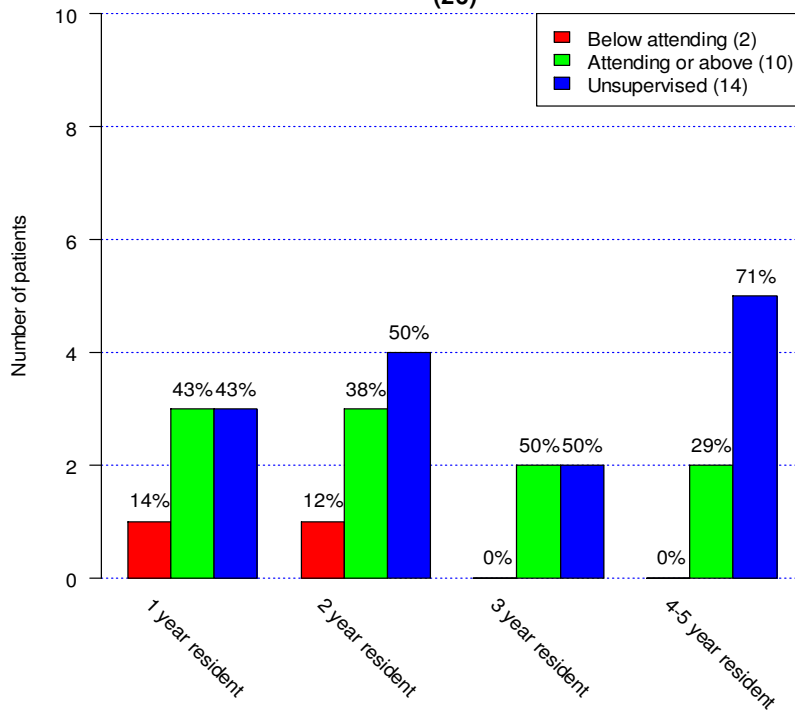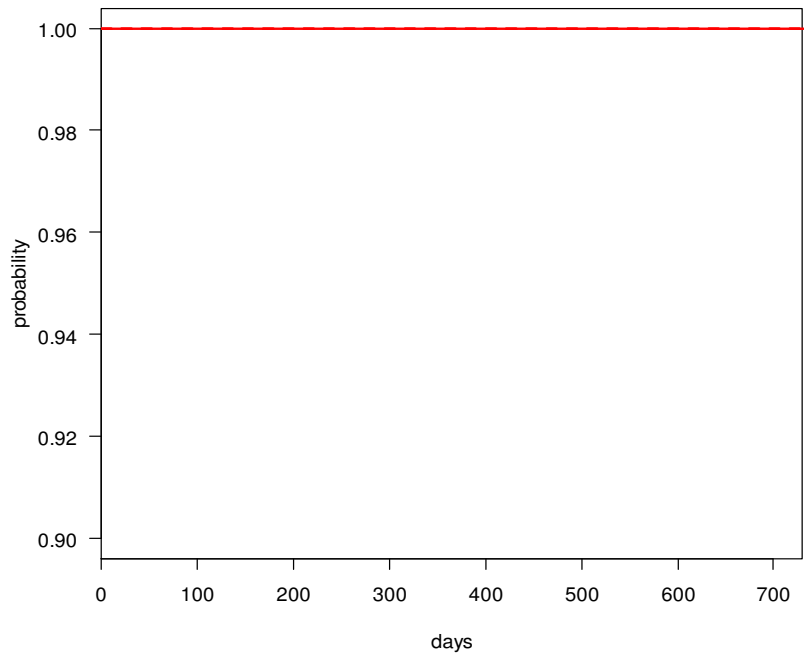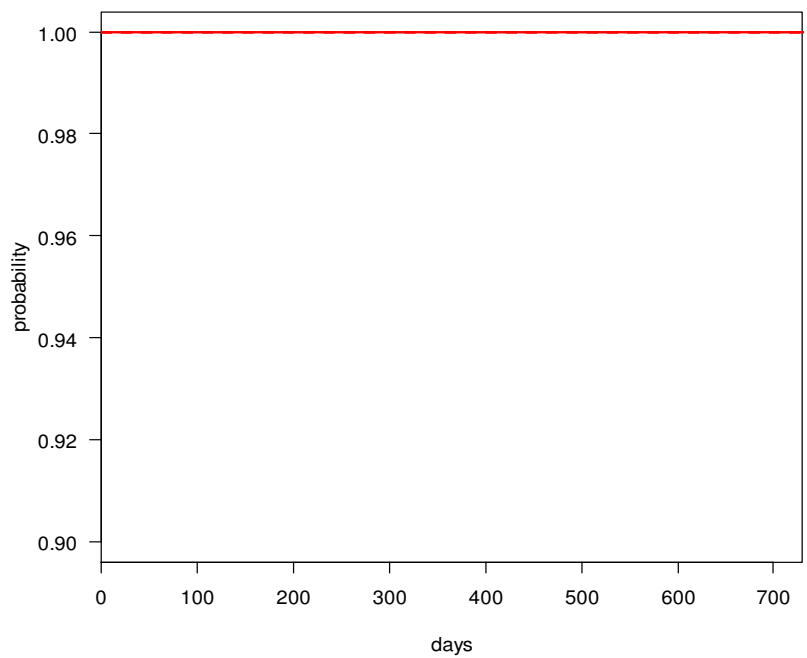## except pain and discomfort from surgical hardware
foot fractures
(45)

Appendix 1

	Registered parameter	Values
Patient related parameters	CPR	Unique ID
	Gender	Male / Female
	Age	Years
	ASA score*	1/2/3/4
Trauma related parameters	Operated side	Left / Right
	Date and Time of the radiological exam**	Time of the day and date
	Major Trauma ***	Yes / No
	Gustillo Type	Closed / 1 / 2 / 3a / 3b / 3c
	Neurovascular status	Unimpaired/ dysthesia /parasthesia / lack of pulse
	Pathologic fracture****	Yes / No
Surgery related parameters	Date and Time of surgery	Time of the day and date
	Procedure Type	Primary / secondary / planned*****
	Fracture Type	Adult / pediatric / periprostetic
	Fracture Diagnosis	AO Müller / Rorabeck / Vancouver classification
	Method of osteosynthesis	Locking plate, non-locking plate, screw (one or more), K-wire, steel wire, cable, threaded wire, intramedullary nail, elastic nail, external fixation (bars), external fixation (ring), hemi arthroplasty , total arthroplasty, sliding hip screw, intramedullary nail with sliding screw (short), intramedullary nail with sliding screw (long), Hook plate, removal of hardware, fracture reduction w/o osteosynthesis, Hook pins, Polyfix, arthroplasty reduction, locking attachment plate, syndesmotic screw(s), ASLS screw for intramedullary, none of the above.
	Supplemental surgical procedures	Arthrodesis, bone resection, osteotomy, bone suture, Bone transplant (autograft), Bone transplant (allograft), Bone transplant (substitute), Amputation, fasciotomy , soft-tissue debridement, brissement, hematoma evacuation, tendon surgery, nerve or vascular surgery, ligament surgery, none of the above, reaming, nerve decompression , secondary suture, meniscal / labral suture, meniscal / labral resection, prosthesis exchange, VAC therapy, skin transplant, joint reduction, arthroscopic assistance.
	Antibiotic prophylaxis	Yes / No
	Use of tourniquet	Yes / No
	Educational level of the surgeon	Intern, 1st year resident, 2nd year resident, 3rd year resident, 4-5th year resident, attending, traumatologist******
	Educational level of the supervisor if present	Intern, 1st year resident, 2nd year resident, 3rd year resident, 4-5th year resident, attending, traumatologist******

*: American Society of Anaesthesiologist (ASA) score

**: Date and time of the radiological examination that provided indication for surgery

***: Major trauma was defined as when a trauma team was assembled upon arrival of the patient to the hospital

****: Pathologic fracture as suspected on radiological exam

*****: A primary surgical procedure is defined as the first surgical procedure due to a fracture. A planned secondary procedure is defined as a surgical procedure that is a part of the primary treatment plan following primary surgery. A reoperation is defined as a surgical procedure that is not a part of an initial treatment plan following primary surgery

******: Traumatologist: attending in orthopaedic surgery with at least 2 years of trauma subspecialization.

Indications for reoperation:
Infection
Muscle- and soft-tissue revision
Neurovascular complication
New fracture
Not identified intraoperative fracture
Suboptimal osteosynthesis
Secondary fracture dislocation or osteosynthesis failure
Pseudoarthrosis
Bone necrosis
Pain or discomfort from osteosynthesis

Indications for reoperation that are registered by the surgeon in DFDB when reoperation is registered.