Svenska Frakturregistret

The Swedish Fracture Register

Annual Report 2013

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The Swedish Fracture Register
www.frakturregistret.se

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ISSN 2001-2276

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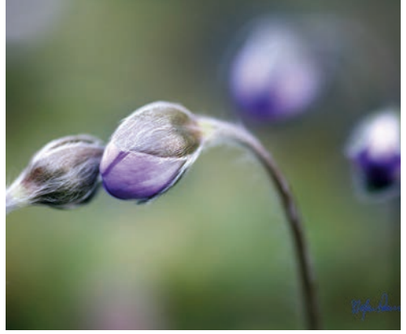
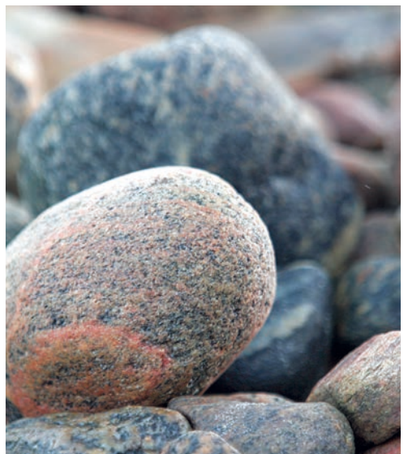
Layout and production: Ibiz reklambyrå • Printing: Litorapid, Hisings Kärra • Photo: Isabel Svensson (cover), Stefan Persson





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Summary

The Swedish Fracture Register (SFR) demonstrated the viability of its concept in 2013. Despite their busy schedules at emergency departments and surgical wards around the country, orthopaedic specialists and residents continually enter injuries and interventions.

A field of medicine must be well-defined, including clearly formulated problems, before genuine progress can be made. Not enough well-founded decision making data are available when it comes to fracture care. As last year's report pointed out, we are in the midst of a comprehensive effort to analyse the state of fracture treatment in Sweden.

A growing number of hospitals have implemented the SFR. The first annual report was based on 2011–2012 data from five hospitals and approximately 6,600 fractures that had been entered. This report for 2013 is based on data from almost 20 hospitals and more than 33,000 fractures. By the time the report is published in August 2014, the SFR will contain data on more than 50,000 fractures. At some point in autumn 2014, the SFR will be in use at over half of the orthopaedic units that treat fractures.

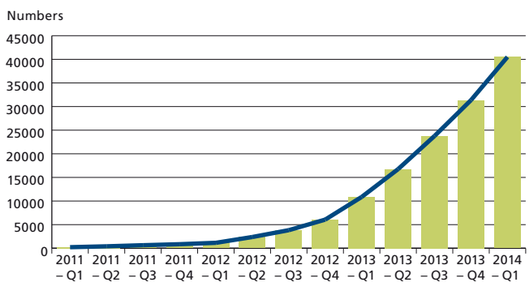
The purpose of the SFR is to lay a solid foundation of knowledge concerning the epidemiology and effectiveness of Swedish fracture care. SFR is an online quality register that permits entry of all types of fractures. Striving to realise that goal is a daunting and sometimes forbidding challenge. One of the most persuasive reasons for entering fractures in the SFR is the opportunity for both individual specialists and directors to obtain extensive real-time data about the clinic's cases, and allow comparison with with the accumulated data from other hospitals. Fractures are registered, regardless of whether been treated by surgical or nonsurgical means, to allow evaluation of the entire fracture spectrum.

This second annual report reviews the evolution and current use of the SFR. The appendix contains background information about the fracture classification and treatment codes presented last year. The volume of data is growing by leaps and bounds. The annual report for 2013 includes general data and data focussed on upper arm, wrist, hip and ankle fractures, as well as Patient Reported Outcome. The data appear in a detailed statistical section of the printed version. Due to space limitations, additional analyses from individual clinics are published in an online version of the annual report along with the printed statistics.

This publication is an abbreviated translation of the annual reports (2013/2014).

Some of the presented figures below are in English translation. In others the Swedish text is an integral part of the image and not easily changed. Despite this, we still believe the figures are comprehensible since they illustrate ICD codes etc.

Accumulated number of fractures in the SFR since its start.



What is the Swedish Fracture Register?

The SFR has enormous potential when it comes to improving the quality of fracture treatment in Sweden. Orthopaedic specialists created the SFR to bridge the gap in register-based knowledge in this area.

Sweden is in a unique position to develop national quality registers and orthopaedics has played a pioneering role. The hip and knee replacement registers have an huge impact both nationally and internationally resluting in improved implant survival and treatment results.

Local and regional fracture registers are used around the world, frequently based on a large hospital and its service area. The data they have generated is largely epidemiological in nature.

Even in the absence of quality registers, some data can be obtained from medical record systems and National Board of Health and Welfare registers. These data are frequently incomplete and/or inexact. For example, a fracture is currently described on the basis of its ICD-10 code. The code identifies the part of the skeleton involved but not the severity of the injury or whether the left or right side was injuried. Drawing any conclusions about whether treatment was satisfactory or is impossible. Nor do the data reveal differences in case mix between the various hospitals. A quality register must include outcome measures as well which medical records cannot provide.

The success of other orthopaedic quality registers in Sweden has spurred demand for similar data about fracture care. The difficulties associated with creating an effective fracture register have no doubt served as a deterrent.

Background

Sahlgrenska University Hospital in Gothenburg designed outlines and rudimentary prototypes back in the 1990s, but they were never tried on a large scale, much less put into practice. Dr Carl Ekholm and Dr Michael Möller, two orthopaedic surgeons in Västra Götaland County, launched a concerted effort in 2007 to identity the variables that a register should include. They also worked on the structure of a possible register and the principles for constructing an interface. An initiative by the Swedish Hip Replacement Register contributed to the establishment in 2009 of the Centre of Registers Västra Götaland. Late that autumn, the developers of the SFR were invited to proceed, now with the support of Region Västra Götaland.

Given that the SFR had been developed by orthopaedic specialists affiliated with Sahlgrenska University Hospital, that was a logical place for clinical trials to start. After a secure authentication solution, including a user card, had been put together in autumn 2010, the first patients were entered on 1 January 2011.

Because the SFR is linked to the population register of the Tax Agency, only people with Swedish personal identity numbers can be entered. Given that we want to ensure accurate data about both the nature of the injury and the type and treatment of the fracture, only cases that are sustained and treated in Sweden can be included. Furthermore, one goal of the register is to permit evaluation of fracture care as provided in the country.

Purpose of the SFR

The purpose of the SFR is to lay a solid foundation of knowledge concerning the epidemiology effectiveness of Swedish fracture care. Such a foundation permits data about the type of fracture, and along with subsequent treatment and its results, to be used as a means of improving quality and making treatment more effective. Users of the SFR enjoy ready access to its data for research and studies.

Very few high-quality randomized studies have been conducted that can provide evidence-based support for fracture care. Several different treatment options are available for a number of injuries, including the commonplace fractures of the shoulder girdle and wrist. Randomized studies on fractures are difficult and time-consuming: the injuries are acute in nature, patients are often elderly with co-morbidity, the type of intervention is chosen on the spot and frequently performed without delay.

Fractures may well represent an area of orthopaedic surgery for which success is based more on the knowledge and skills of the practitioner than the particular implant that is used. Nevertheless, certain kinds of operations can be standardised with respect to both the technique and choice of implant. Other interventions for fractures cannot be standardised even though the basic principles are well known.

Register data that describe the way that various types of fractures are treated de facto and the results that are achieved have great potential value for patients, not to mention orthopaedic specialists and healthcare providers.

Implementation and Coverage

The SFR has allowed entry of more and more parts of the skeleton as time goes on. In addition to the long bone fractures registered from 2011, registration of fractures of the hand, pelvis, foot and shoulder has been possible since October 2012. Preparatory work on spinal and paediatric fractures in 2013 will lead to implementation in 2014. The main focus in 2013 was on attracting additional departments and starting up at the ones that had exhibited interest.

Implementation

The SFR could be introduced at additional hospitals as of April 2012. Information about the SFR has been disseminated primarily at national conferences (annual meeting of the Swedish Association of Orthopaedic Surgery and Traumatology, Fracture Days and the meeting of the Swedish Orthopaedic Association). Information has also been e-mailed to directors of orthopaedic departments around the country, particularly in connection with distribution of the first annual report in September 2013.

More than half of the orthopaedic units that treat fractures have announced their interest in participating. The SFR has been most successful in joining orthopaedic departments in central Sweden but less so with those in the northern and southern parts of the country.

Based on requests by the various departments, representatives from the SFR make presentations to management teams, fracture specialists and groups of doctors. One or two visits are paid to each department in preparation for the startup. Departments entering data or plan to do so in the near future are invited to user meetings.

Three or four months of preparation are normally required after the visits before registration can begin. The scope and requirements of the SFR demand discussions about access to local various resources. For departments working to improve their standard of care, the large quantity of data available through the SFR has provided a strong incentive for participation. Groups of orthopaedic units have started to coordinate their services in several parts of the country (Stockholm County Council and the Southeast Healthcare Region). They have recommended a joint policy and designated one or two departments to participate in SFR on a trial basis. Some departments have started off by entering only certain types of fractures, usually of the upper extremities but the majority have begun to enter all types of fractures.

Expansion

The following centres were entering data in the SFR at the end of 2013: Gothenburg, Mölndal, Alingsås, Kungälv, Skövde, Karlstad, Sunderbyn, Borås, Uddevalla, Kalmar, Örebro, Östersund, Eskilstuna, Västerås, Gävle, Hudiksvall and Lidköping. A few entries were made in Uppsala and Linköping, as well as at the Hand Surgery Department in Gothenburg. Södersjukhuset, Stockholm is adopting the SFR on a gradual basis.

As of May 2014, Falun is also participating. Our strategy for involving more units is to visit those that have contacted us and presently dialogue is ongoing with many departments. The following departments have decided to start up in autumn 2014: Karolinska Hospital in Huddinge, Karolinska Hosptial in Solna, Danderyd, Västervik, Eksjö, Jönköping, Värnamo and Norrköping. Uppsala will transit from entering pelvic fractures only to full participation.

Coverage

Collaboration has begun with the Register Service at the Board of Health and Welfare to find a method of measuring the coverage of the SFR in relation to the Patient Register (PAR). The process is fairly complex: fractures can be assigned to a number of different treatment codes, any particular patient can sustain new fractures, and an individual fracture may be treated on multiple occasions on either an outpatient or inpatient basis. Another problem is that the PAR does not specify the side of the body that the injury involved. A research project launched in 2013 is comparing entry of humerus fractures in the SFR with data in the PAR.

Centres affiliated with the SFR can start off by entering either all types of fractures or selected parts of the skeleton. Nearly all of them are now participating fully. Those that have joined most recently, including Örebro and Falun, took the plunge from the very beginning.

The departments that initially started with a limited registration chose those of the upper extremities. Their reasoning was that most unresolved treatment issues concern fractures of the wrist, shoulder area, etc.

Some units chose not to send out patient questionnaires until they were familiar with the register. As of 2014, all units will be distributing the questionnaires.

The SFR quite possibly faces a greater challenge in collecting data than any other national quality register in Sweden. The volume of data is enormous, there are many different types of fractures, and nonsurgical interventions are also included. Determination of the coverage vis-à-vis the PAR is easiest for the types of fractures that require hospitalisation. One issue when it comes to local and county administrative systems is that it is difficult to assess whether the codes that have been entered there are correct or not.

High-quality data are crucial to reach the purpose of the SFR: monitoring performance, promoting ongoing improvement efforts and encouraging clinical research. Thus, both the data validity and the coverage needs to be high. Meticulous validation is of limited utility until the coverage has reached a certain level.

Our strategy and objective are to meet the four criteria normally encompassed by the concept of coverage. The most important criterion is coverage, i.e the percentage of units that enter data. Departments need to carefully validate their entries to ensure the greatest possible completeness (inclusion of individual patients). Once an injury has been entered and/or a patient has returned a questionnaire, the validation functions generate an error message for missing data. Towards the end of the year, all participating units are urged to supplement their data. Apparently they have complied admirably, given that there are few missing values in relation to the total volume of data that has been collected.

Validating the response rate to patient questionnaires is also essential in order to achieve the greatest possible participation. The SFR is launching targeted studies of the response rate.

Once the SFR has been consolidated further, local monitoring efforts will be a necessary, if arduous, component of the strategy to improve both the coverage and data validation. It would be difficult to perform an exhaustive analysis of the coverage for all types of fractures, but analyses of individual types are already under way with the Board of Health and Welfare through the PAR. In view of the above considerations, predicting when the SFR will reach 90–95 per cent completeness in line with some of the mature registers would be a futile exercise. The Swedish Hip Replacement Register and others that measure only one type of surgical intervention have a coverage of 100 per cent coverage and 98 per cent completeness but it took approximately 15 years after starting up in 1979 to reach that point.

Estimates have been performed concerning the number of fractures treated on an inpatient basis or at specialised outpatient clinics that have been entered in the PAR and that involve the ages and types currently included in the SFR. The conclusion is that Swedes sustain approximately 100,000 fractures per year. Approximately 2,500 are currently being entered in the SFR every month, corresponding to 30,000 annually. Approximately 6,000 fractures had been entered at the end of 2012 and 32,000 at the end of 2013. As of May 2014, more than 43,000 fractures had been entered since the SFR started up.

Statistics

The statistical section of this annual report is only a sample of what can be analysed on the basis of the variables that the SFR collects. The statistics presented this year are taken from the first fractures (approximately 33,000) that were entered. Based on an increase of 2,500 per month, approximately 49,000 will have been entered once this report has been finalised in summer 2014.

While the statistics are mostly descriptive in nature, Patient Reported Outcome Measures appear for the first time, though limited to the upper arm and lower leg. When studying the data, keep in mind that their quality and coverage may vary at a particular department. Nor should the figures be interpreted as an accurate reflection of true incidence, except for at a few centers with a high coverage. Consistent data over time at individual units will suggest that their coverage is high. By the same token, observed agreement of fracture patterns between units may suggest that their classification practices are similar. For those who are interested, the report contains a large quantity of thought-provoking data. Unless otherwise stated, the diagrams and tables refer to total data from the entire register.

Patient Reported Outcome Measures following treatment of tibia and humerus fractures have never been presented in this form before. These data should be interpreted with some caution. The response rate of approximately 50 per cent may be impressive given the patient population in question but is nevertheless a factor to consider.

Reoperation rate, the second outcome measure, also needs to be interpreted with caution. For one thing, all registers are likely to underreport reoperations; for another thing, it is difficult to detect the fact that a reoperation has not been entered. Since many different types of operations, each with their own code, are performed for fractures, the SFR is particularly susceptible to such limitations. For that reason, validation projects are under way in this and a number of other areas (see the “Validation Effort” section).

We are deeply indebted to the departments that enter data, thereby improving the statistical base that will enable us to evaluate and improve the treatment of patients with fractures.

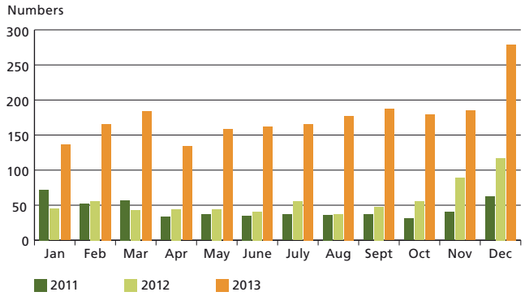
Once again, we extend an invitation to the orthopaedic departments that are not yet affiliated to help us achieve a high national coverage, not to mention more accurate and relevant results.

ICD CODES

S 32.80 = Fracture of pelvis
S 42.00 = Fracture of clavicle
S 42.20 = Fracture of upper end of humerus
S 42.30 = Fracture of shaft of humerus
S 52.10 = Fracture of upper end of radius
S 52.50 = Fracture of lower end of radius
S 52.60 = Fracture of lower end of both ulna and radius
S 62.00 = Fractures of scaphoid bone
S 62.30L = Fracture of fifth metacarpal bone
S 62.30R = Fracture of forth metacarpal bone
S 72.00 = Fracture of neck of femur
S 72.10 = Trochanteric fracture
S 72.20 = Subtrochanteric fracture
S 72.40 = Fracture of lower end of femur
S 82.00 = Fracture of patella
S 82.10 = Fracture of upper end of tibia
S 82.60 = Fracture of lateral malleolus
S 82.80 = Bi/tri malleolar fracture
S 92.30B = Fracture of fifth metatarsal bone
S 92.30Z = Fracture of other metatarsal bone
S 92.40 = Fracture of great toe

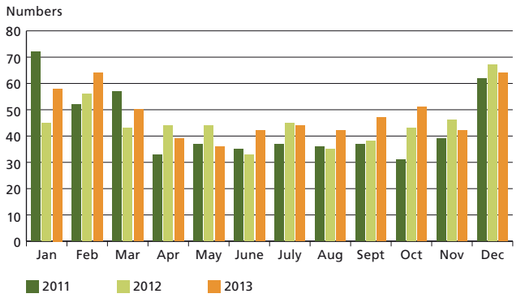
Upper arm

Figure 1. Number of proximal upper arm fractures (ICD S42.2) entered per month, i **SFR,** 2011–2013.



The growing number of fractures entered in 2013 is due to the fact that more clinics were participating.

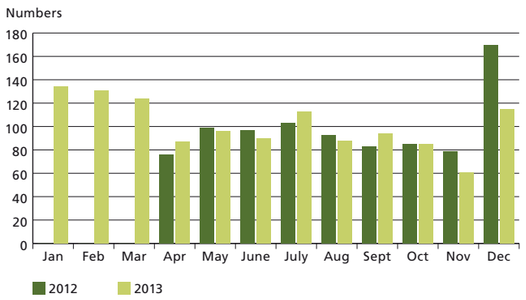
Figure 2. Number of proximal upper arm fractures (ICD S42.2) entered per month in **Göteborg/Mölndal,** 2011–2013.



Proximal upper arm fractures exhibit seasonal variations, including greater incidence during the winter months.

Wrist

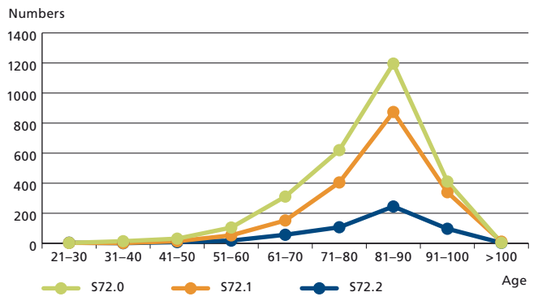
Figure 3. Number of wrist fractures (ICD S52.5/6/8) entered per month in **Göteborg/Mölndal,** 2012–2013.



Wrist fractures in Gothenburg/Mölndal exhibit uniform incidence per month except for occasional peaks during the winter. The growing numbers in the SFR for 2013 simply reflect the fact that more clinics had started participating.

Hip

Figure 4. Age at the time of injury for patients with hip fracture (ICD S72.0/1/2) in 10–year intervals, **SFR,** 2012–2013.



Note the well-known pattern: mostly cervical hip fractures, followed by trochanteric fractures. All types peak at age 81–90.

Patient Reported Outcome Measures (PROMs)

The EQ-5D consists of five questions (dimensions) with three response alternatives. The responses generate a profile with a score from 0 to 1 on an ascending scale of health-related quality of life.

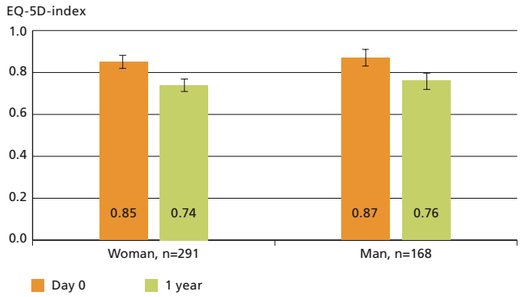
The second questionnaire with which patients are asked to rate their health and capacity is referred to as the Short Musculoskeletal Function Assessment (SMFA). The form consists of 46 question broken down into 6 groups: daily activities, mobility, functionality, bother, arm/hand function and wellbeing. The questionnaire is scored on a descending scale of 0 to 100.

The diagrams show correlations suggesting that the instruments can help address the question of how well function has been restored one year after a fracture or fractures. Given that the samples consist of a limited number of patients with humerus and tibia fractures who responded to questionnaires at baseline and one year later, no detailed conclusions can be drawn.

A more detailed statistics section is available in the Swedish version of the annual report only. The figures presented here are a small sample.

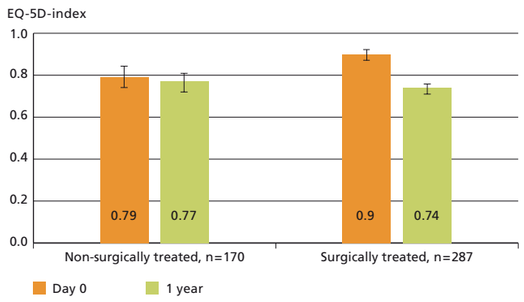
PROM Tibia EQ-5D

Figure 5. EQ-5D-index, at baseline and 1-year follow-up (ICD S82.1/2/3), 2011–2012, by **gender.**



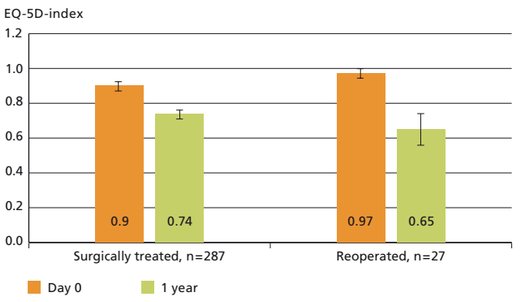
The value of presenting the EQ-5D-index is a topic for discussion. Many quality registers and other healthcare services use the index. This diagram shows the averages for women and men. The gender gap is small, but there is a difference between baseline and 1-year follow-up. Because the data are limited, the annual report does not contain any detailed analyses.

Figure 6. EQ-5D-index, at baseline and 1-year follow-up, for patients with tibia fractures (ICD S82.1/2/3), 2011–2012, **surgically** and **non-surgically treated.**



Whether these numbers suggest that surgical interventions should be avoided for tibia fractures is questionable. Future subgrouping into types of fractures and the ages of the patients will hopefully provide more information about their self-reported health and function following various kinds of interventions.

Figure 7. EQ-5D-index, at baseline and 1-year follow-up, for patients with tibia fractures (ICD S82.1/2/3), 2011–2012, **surgicallly treated** and **reoperated.**



Given that there are only a few patients, great caution should be exercised when interpreting these numbers. Reoperation is a negative event indicating that the treatment plan had to be modified while the fracture was healing. It is hardly surprisng that self-reported health and function would be poorer as a result. The endpoint of reoperation is probably related to the register's other outcome measures from patient questionnaires.

Validation

SFR data is continually validated in several different ways. The online interface has input checks that minimise the risk of certain types of errors, such as a treatment date that precedes the actual injury, only relevant treatment codes are displayed for a particular type of fracture and patients younger than 12 cannot be entered.

To facilitate complete entry, users at an individual centre can continually search for fractures that have not been classified, whose treatment has not been entered, whose scheduled follow-up intervention has been entered but not the primary procedure, etc. Participating units received this information in early 2013 for validation of all data from 2011–2012. Since May 2013, this function can be maintained on a continual basis. Reminders to verify that it is being done were sent out at the end of 2013. We therefore regard the data presented in the annual report as complete as possible at present.

There is little doubt that entry of reoperations is one of SFR's weaknesses at this point. All quality registers that use reoperation as an outcome measure are presumably in the same position. A research projected to begin in 2014 will look closely at the problem. The fact that a reoperation has not been entered is detected only when the data are matched with another reliable source to which such procedures have been reported. The SFR still faces a major effort to determine the reliability of the PAR with respect to reoperating on fractures. The possibility that the PAR is subject to a number of different sources of error, interpretation difficulties and incomplete reporting is not hard to imagine.

Each department needs to ensure as much completeness as possible when it comes to the percentage of fractures it enters over a particular period of time. Various systems of automated report generation have been designed to identify fractures that have already been sustained. The basic approach is to track injury diagnosis numbers in medical record systems.

The Register Service at the Board of Health and Welfare can lend its assistance in performing coverage analyses. SFR has commissioned such an analysis for the latest available figures (2011) in relation to the PAR. Given that the SFR contains data about many different diagnoses, types of treatment and treatment codes in both inpatient and outpatient care, qualified analyses is needed to offer a fair view of the coverage at a particular unit. A research project to come up with a detailed analysis down to the individual level regarding conformance between the SFR and PAR has been in progress since 2013.

The process of classifying fractures by type demands careful evaluation. Such classification must meet stringent minimum requirements if the data are to impart knowledge that is significantly more reliable than the current ICD-10 codes provide. Thus, the participating units should conduct validation studies that focus on the reliability of their classification procedures. Studies conducted in 2013 validated classification systems with regard to inter-observer and intra-observer reliability while comparing the results of experienced classifiers with the types of fractures that are entered in the SFR. Additional studies of the same type are on the drawing board.

At some point, SFR will begin to monitor the participating departments as resources permit. Medical record and register data should be compared on site to ensure correctness and completeness with respect to everything from dates to the interventions that have been administered.

Global Interest

The Swedish initiative to develop the SFR attracted international interest already during the conceptual and planning stages. Sweden's hip and knee replacement registers are widely known, and requests have poured in from around the world to include fractures as well.

Our hope is that we will be able to live up to the expectations for important results that are starting to emerge. The most important thing at this point, however, is that the SFR take the time to evolve and be implemented in an organic manner. The SFR will begin to generate the kind of information that can make a fundamental difference once we have proceeded from an interpretation of the results to the articulation of goals for which fracture care should strive. Assuming that the SFR can help improve Swedish fracture treatment, the eyes of the world will remain on us.

Our collaboration with groups abroad that are interested in systematization of fracture data is based on their national and international connections. So far we have developed contacts and plans for collaboration with Norway and Denmark.

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Structure

The SFR is an online quality register that uses paper only when posting questionnaires to patients. Its Stratum platform was designed by the Centre of Registers Västra Götaland. The goal of the SFR's structure and appearance is to ensure an intuitive, user-friendly interface.

A selection of clear and straightforward choices permit the entry of a relevant but limited number of variables. All variables are explained by means of tooltips, which appear as soon as the user moves the cursor over the associated variable. The user can activate or deactivate this function at will. Classification of fractures is based on selectable images of the various types. Once a particular type of fracture has been chosen, the user is asked whether it is open or not, perhaps whether it was dislocated, etc., as well. A few choices and clicks of the mouse can generate a large quantity of data presented in terms of well-known, validated and clinically relevant coding and classification systems.

The SFR has been structured to handle injuries that lead to one or more concurrent fractures, as well as subsequent injuries sustained by the same patient. The interface is reminiscent of a parchment scroll in which the timeline moves from top to bottom. Each injury and its associated fractures, interventions and Patient Reported Outcome Measures are added as they arise without sacrificing the clear, straightforward structure. Reoperations performed much later are still linked to the primary injury. The page that shows data for an individual patient looks like the cover of old patient charts, displaying both diagnoses and periods of care.

Development process
The pilot phase from 2011 to early 2012 involved entry of humerus and tibia fractures for more than 1,000 patients at Sahlgrenska University Hospital in Gothenburg and Mölndal. The structure of the SFR worked as intended and only minor adjustment were required. Meanwhile, classification systems for other fractures were adapted to the needs of the SFR and the various types were matched with ICD-10 codes. Treatment codes for primary interventions and reoperations were selected for each type in order to minimise the risk of erroneous input by reducing the number of choices available to the user as much as possible.

As of 1 April 2012, entry is possible for all types of orthopaedic fractures – those of the long bones, pelvis, acetabulum, clavicle, scapula and foot. Entry of hand fractures was possible as of autumn 2012 and began on a large scale on 1 December of that year.

Description of the Variables

Any quality register that is to provide significant new information about fracture treatment and its results must contain satisfactory variables. Facing the huge number of future fracture registrations it has been essential to keep the number of variables to register down to a minimum.

What variables are entered and why?

When the goal is to generate new knowledge in a complex area, it is easy to be seduced into thinking that there are many variables that are too important to be excluded. We have minimised the number of variables in an attempt to achieve a high coverage and ensure a successful register. Patient questionnaires are used when appropriate. Other questions will be added to the register as needed. Additional variables and information can be accessed in the process of matching with external registers.

FThe following variables are entered in the SFR

Description of the injury:

- Personal identity number Real-time linked to the Tax Agency population database. Thus, foreign citizens and people with temporary personal identity numbers cannot be entered.
- Date of the injury.
- Cause of the injury (by ICD-code in the V and W ranges).
- Non-traumatic fracture. When applicable, stress, pathological or spontaneous fracture are specified instead.
- Type of injury (high-energy or low-energy)

Description of the fracture:

- Side of the body and part of the skeleton are chosen from a schematic diagram.
- Type of fracture. Chosen from a schematic diagram and brief caption. Each fracture (i.e., a skeletal injury that is visible on some kind of X-ray) is entered. The choice generates the fracture's ICD-10 code, as well as a more detailed code, usually with 4 or 5 places in accordance with the AO/OTA system.
- Whether the fracture is open or closed is entered without further classification.
- Prosthesis/implant-related fracture. Any prosthesis that is near the fracture or any implant to which it is related are entered and anatomically subgrouped.

Description of treatment:

- Date of treatment
- Type of treatment (surgical, nonsurgical, reoperation, etc.)
- Treatment code. The alternatives are shown in text form but the code is entered in accordance with Classification of Health Interventions, often 6 places instead of 5 in order to permit greater detail.
- Training level: The surgeon's level of education and experience is specified when applicable.

Multiple fractures can be entered for each injury and more than one intervention can be entered for a particular fracture, either on the same day or in chronological order if repeated surgical interventions are required.

Patient Reported Outcome Measures:

Shortly after the injury, patients report their level of function as it was before the injury (recall technique). They answer the same questions a year later to permit an assessment of the degree to which pre-injury function has been restored.

- The EQ-5D with three response alternatives is used.
- The VAS scale (EQ VAS) for general health is used.
- The Short Musculoskeletal Function Assessment (SMFA), which reflects both general health and function of the upper and lower extremities, is used to ensure greater specificity.

Since 2013, whether the patient, a family member or a caregiver filled out the questionnaire can also be noted. A question on smoking habits has been included since 2013.

Administrative variables:

Variables 17–19 are related to the possibility that the fractures of a particular patient may be treated at different hospitals based on their severity. The variables are also needed because the Personal Data Act prohibits a user from viewing entries made at another care provider.

- Entry can include a notation that the patient does not belong to the department's primary service area.
- A notation can also be made if previous treatment has been provided at another hospital or if such plans have been made for the future.
- It is also possible to specify that an intervention to be entered is being performed at another hospital.

Classification Systems

A fracture cannot be correctly treated unless it is analysed and described. The ICD-10 codes represent the only standardised and routinely journalised fracture classification system in Sweden. The codes specify only the part of the skeleton in which the fracture is located. In addition to location, we describe a fracture in terms of simple, comminuted, intra-articular, close to a joint, major/minor dislocation, high-energy/low-energy, after which we choose an intervention and can make a prognosis.

A uniform system for describing the appearance of a fracture improves the stringency and communication that are inherent to a shared terminology. It follows that use of some kind of refined classification system is integral to creating an effective fracture register. It presumably represents the single most important variable that we have added to the information that can currently be extracted from medical records.

The process of choosing a classification system for the SFR proceeded from a desire to satisfy a number of criteria:

- The system should be comprehensive in the sense of being applicable to all parts of the skeleton
- All types of fractures should be included for each part of the skeleton
- The system should be meaningful – the various categories should make clear distinctions in terms of both prognosis and treatment
- The system should be widely known and used in other countries
- Studies should have demonstrated the usefulness of the system
- The system should be well-structured and user-friendly

No single classification system meets all of the above criteria. The AO Foundation/Orthopaedic Trauma Association system meets more of the criteria than any other classification system. However, it has several disadvantages – its most complex version is too detailed to be practical and it has a geometrical basic structure: each bone is divided into three segments, each segment into three categories, each category into three groups, and so on As a consequence, some common fracture types appear only at a more detailed level. AO/OTA is not the generally used system when it comes to certain parts of the skeleton for which orthopaedic specialists are more familiar with other classification systems. Despite these reservations, we concluded that the advantages of AO/OTA outweighed the disadvantages and chose it as the basic system for use by the SFR.

The second level of nine categories under three segments (A1–C3) seemed to be the most reasonable for a broad-based fracture register. We also decided to use other well-known classification systems for the clavicle, scapula, proximal forearm and several other parts of the skeleton.

The AO classification system has been evolving for decades thanks to efforts by teams of experts around the world. Headquartered in Davos, Switzerland, Arbeitsgemeinschaft für Osteosynthesefragen (AO) is a worldwide organisation consisting primarily of orthopaedic surgeons specialising in fractures. The group has been working on documentation, instruction, research and implant development since 1958. AO is the fracture organisation that has had the single greatest impact over the past 50 years, and its classification system is widely used in both research and clinical practice, often a requirement of publication in scientific journals as well.

The Orthopaedic Trauma Association (OTA), the leading American fracture organisation, collaborates with AO and uses essentially the same classification system. Parts of the OTA system do not have a corresponding, validated classification in the AO system. For that reason, the SFR uses somewhat modified OTA categories for foot fractures.

Classification of a fracture is based primarily on radiological examinations. The SFR uses the best available examinations – often X-rays, but CT scans and other methods are also common. If surgery or other evidence generates additional information about the appearance of a fracture, the classification can be adjusted.

Classification of fractures may in the future be automated by means of image recognition based on specified characteristics. These characteristics are today displayed when the user moves the cursor over the image.

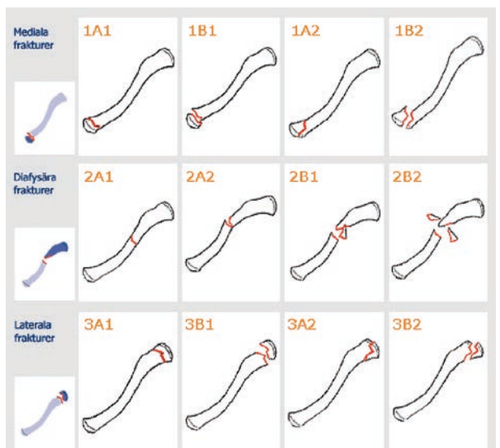
It goes without saying that strict classification requires additional background information. The orthopaedic literature provides various forms of such knowledge. Sample X-rays and supplementary, explanatory text, etc., can gradually add information to the SFR. For the sample fractures below, the online application displays an explanatory caption when the user moves the cursor over a particular box.

In some of the figures presented below the Swedish text is an integral part of the image and not easily changed. Despite this, we still believe they are comprehensible in this context.

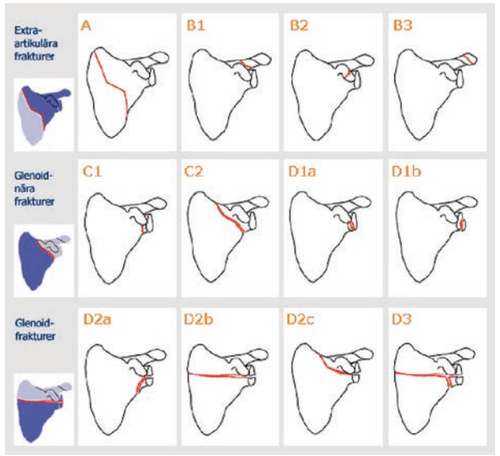
Classification of fractures of the upper extremities

Most types of fractures are coded in accordance with the AO/OTA system. Among them are those of the humerus, forearm (diaphyseal, distal) and hand. When the second (A1–C3) level is unable to describe the wide variation in the type of fracture, we add patterns that appear at the more complex levels of the AO system. We use other classification systems for fractures of the scapula, clavicle and proximal forearm. The original AO system does not include the scapula. A number of other classification systems have emerged. We have settled on Euler Ruedi, which is well-known in Europe, with a minor modification based on Ideberg's system for classifying glenoid fractures.

Klavikelfrakturer



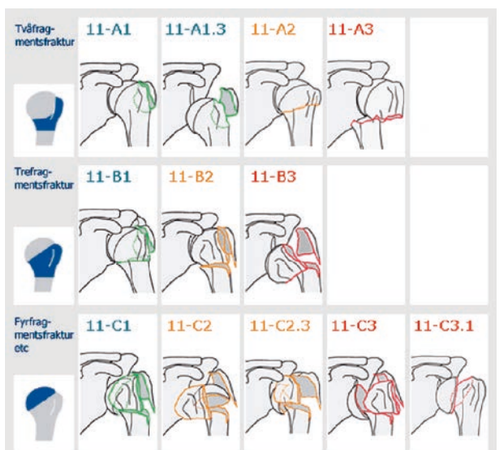
Scapulafrakturer



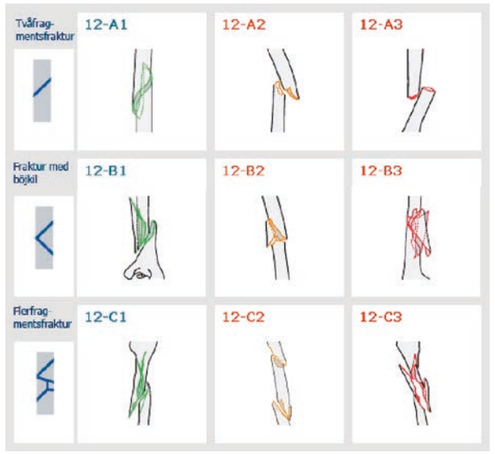
For the reasons stated above, we use the system developed by Robinson for fractures of the clavicle.

We have modified the AO/OTA system for fractures of the proximal humerus. The approach is closely related to Neer, LEGO and other widely used systems. Because the second level does not capture the wide variation in fracture patterns, we have added additional fracture patterns from a more complex level of the AO system.

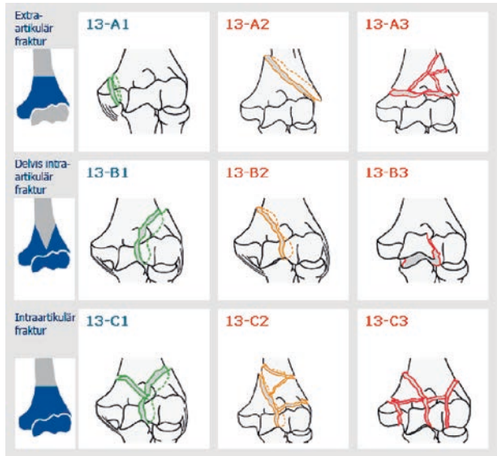
11 Proximala humerusfrakturer



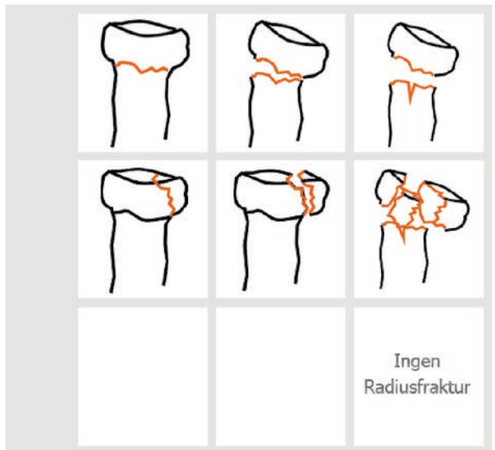
12 Diafysära humerusfrakturer



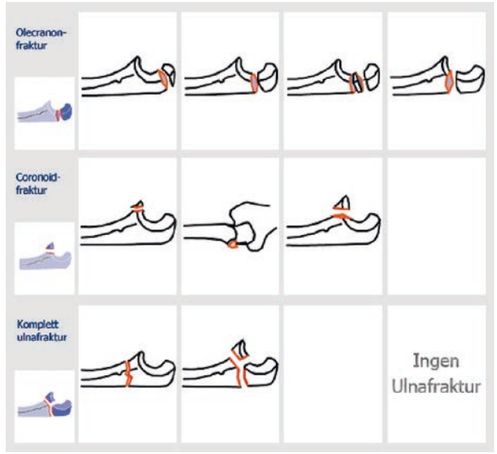
13 Distala humerusfrakturer



21-A Proximala radiusfrakturer



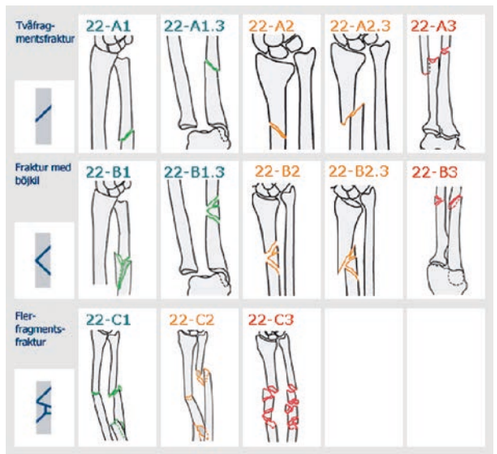
21-B Olecranonfrakturer



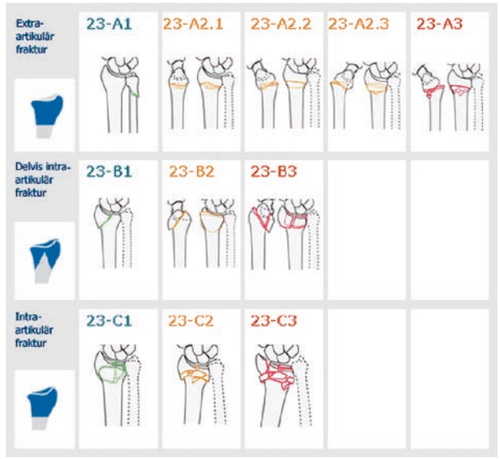
Given that fractures of the proximal forearm involve injuries of the radius or ulna, either separately or in combination, a number of different patterns are possible. As a result, the AO system is complex and cumbersome. Thus, the SFR employs a two-step approach to classification. The fracture of the proximal radius is classified in accordance with Mason, after which the ulna component is classified in accordance with Mayo (olecranon) and Morrey (coronoid). Thus, the two well-known systems are combined to form a comprehensive whole.

Diaphyseal and distal fractures of the forearm are classified in accordance with the AO/OTA system, along with additional variations from the more complex levels.

22 Underarmsfrakturer



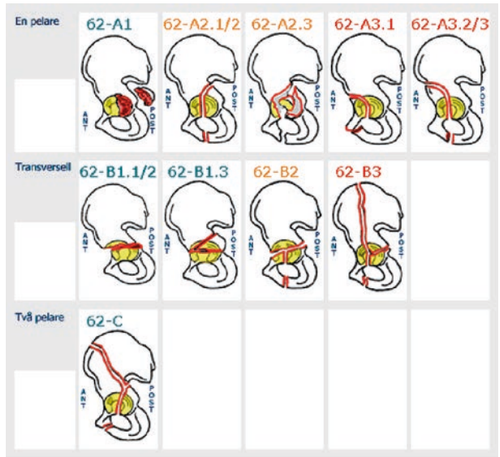
23 Handledsfrakturer



Classification of pelvic fractures

The SFR classifies fractures of the acetabulum and pelvic ring separately. Fractures of the acetabulum are classified in accordance with the well-known Letournel system. Since all ten types are found in the AO/OTA system, they have been designated accordingly. As a result, we have ensured complete congruence between the systems. Certain fractures are assigned to the acetabulum even though they involve parts of the pelvic ring.

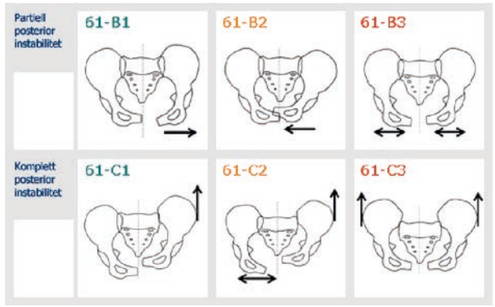
62 Acetabulumfrakturer



Fractures of the pelvic ring

These fractures often consist of several components, certain combinations of which destabilize the pelvic ring. To facilitate classification, the procedure has been designed differently than for other fractures. The first step includes an overview of the pelvis that specifies each fracture component. Each one of them is assigned an ICD-10 code. The second step includes interpretation of the fracture in accordance with the AO system. The system recognises whether the fracture is stable (segment A in accordance with AO/OTA) or unstable (segment B or C); stable pelvic ring fractures are automatically assigned the correct AO code (segment A). For unstable fractures, the user must define the pattern in the next sequence of images in order to obtain a correct final code (categories B1–C3). In other words, an unstable pelvic ring fracture is summarised by means of a single AO/OTA code even if it has multiple components.

61 Bäckenfrakturer



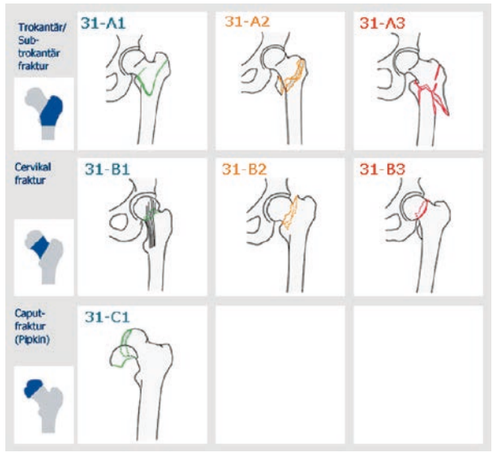
Classification of fractures of the lower extremities

Fractures of the hip can be classified in accordance with degree of stability and dislocation by a number of well-known systems, including Garden's classification for cervical hip fractures. Nevertheless, the AO system can be used for all types of hip fractures without introducing any difficulties or ambiguities with which Swedish orthopaedic specialists are not already familiar. We have also been careful to use the same criteria and designations as the well-established Swedish National Hip Fracture Register (RIKSHÖFT). That way the SFR and RIKSHÖFT are wholly compatible when it comes to the classification variable. The AO system includes cervical and trochanteric fractures, as well as Pipkin (segment C) fractures. These uncommon fractures split the femoral head.

They are usually seen in younger people following high-energy fractures and are not included in RIKSHÖFT.

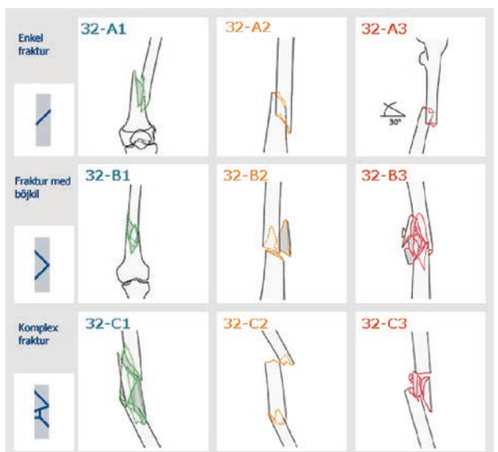
Since the SFR covers all fractures including younger patients and multiple traumas it essential to classify also such hip fractures.

31 Höftfrakturer

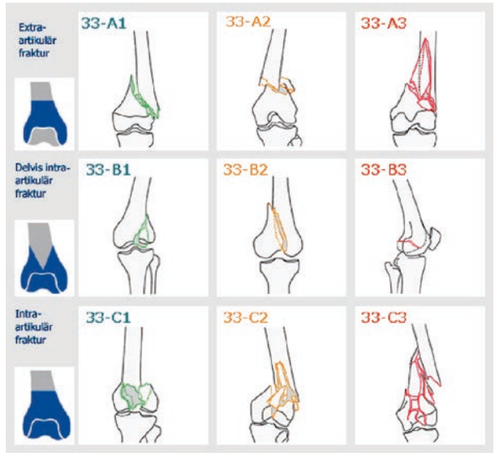


The SFR classifies all fractures of the femur, tibia/fibula and patella in accordance with the AO system. In clinical practise the Schatzker system is commonly used to classify intraarticular fractures of the proximal tibia. The Schatzker groups are included in the AO system which is more complete as it also covers extraarticular fractures.

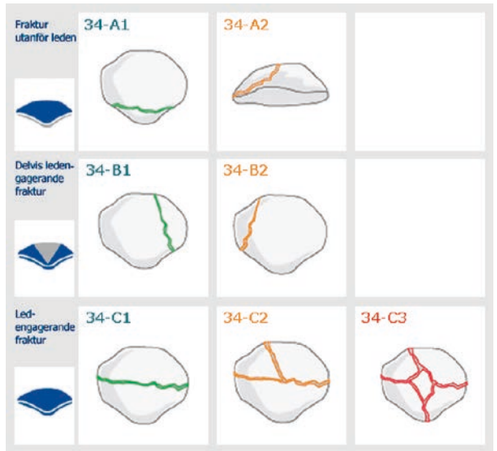
32 Diafysära femurfrakturer



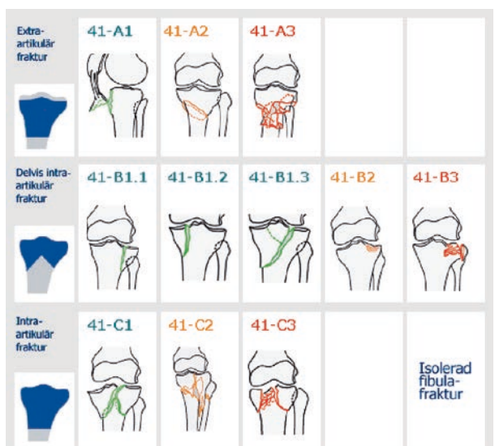
33 Distala femurfrakturer



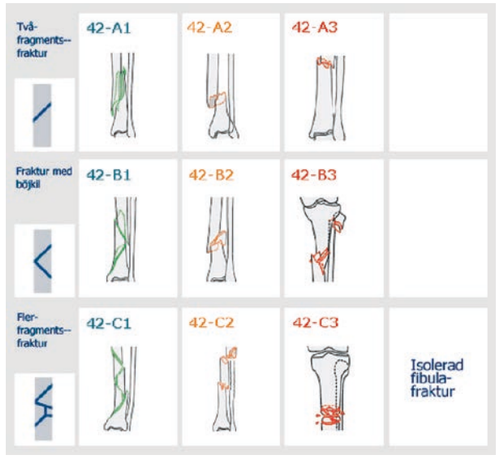
34 Patellafrakturer



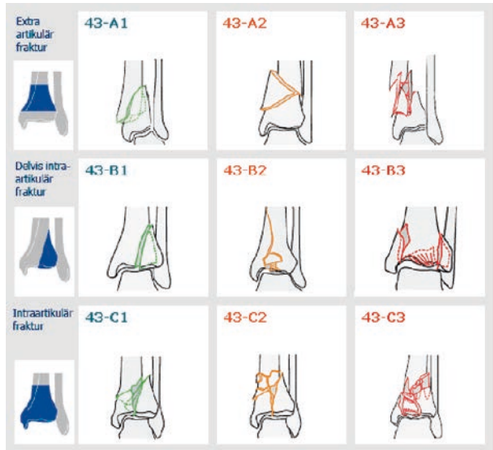
41 Proximala tibiafrakturer



42 Diafysära tibiafrakturer



43 Distala tibiafrakturer

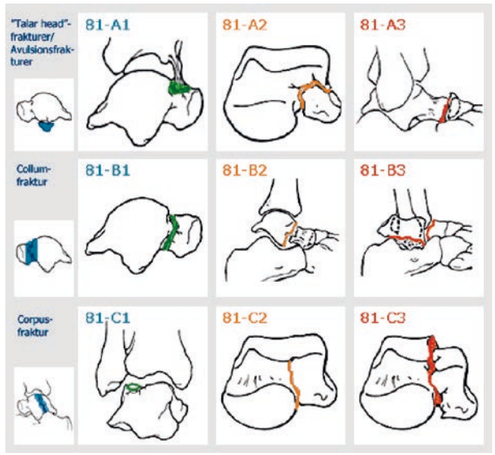


The AO system classifies diaphyseal long bone fractures on the basis of appearance, from those with two fragments to complex ones with multiple fragments. Classification of fractures at either end of the long bones is more intricate given that both appearance and degree of joint involvement must be taken into consideration. For tibia fractures near the knee and near the ankle joint, we have added several types from the more complex levels of the system. The goal has been to optimise clarity and avoid misclassification of common types of fractures.

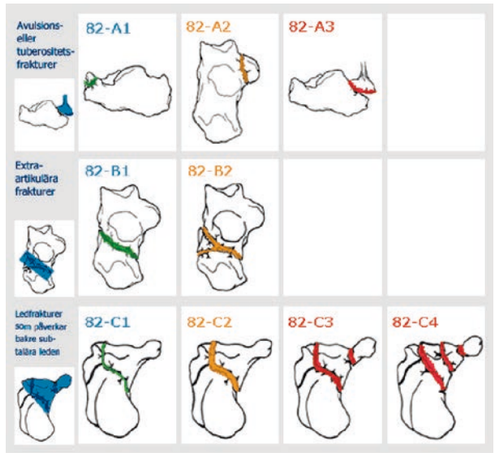
The severity of foot fractures can vary from simple injuries of individual toes to debilitating types of the metatarsus and hind foot. Between these two extremes are many types of fractures whose long-term severity is relatively unknown. Combined with certain types of malunion, ostensibly minor fractures can seriously affect walking, along with pain on weight bearing and persistant ache. As a result, all skeletal injuries of the foot can be entered in the SFR. We have proceeded from the OTA system, which is logical and relatively easy to use, even for severe fractures of the calcaneus and talus. We have simplified the OTA system when it comes to fractures of the toes and metatarsal bones, limiting entry at this stage to specifying the particular bone that is involved. In terms of injuries to the Lisfranc joint, it is important to record both skeletal and ligament injuries. Thus, we have modified the classification and departed from the inclusion criteria of the SFR. Pure ligament injuries in the joint complex can also be classified even if there is no visible skeletal fracture. The injury is serious and amenable to the same treatment as when skeletal fractures are also visible.

44 Fotledsfrakturer

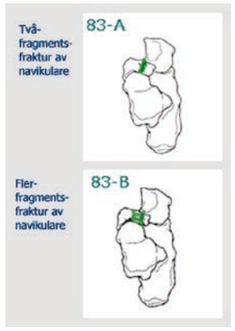
81 Talusfrakturer



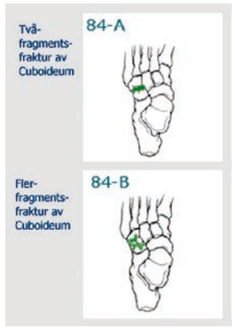
82 Calcaneusfrakturer



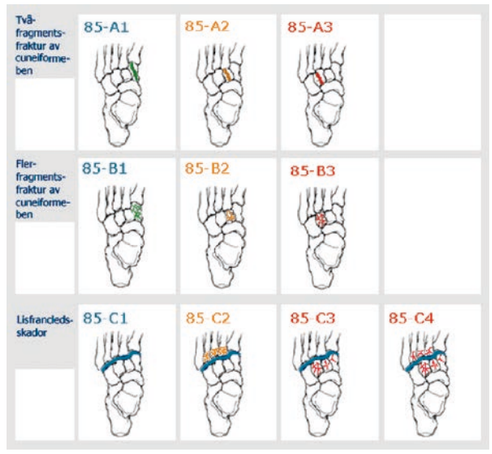
83 Navicularefrakturer



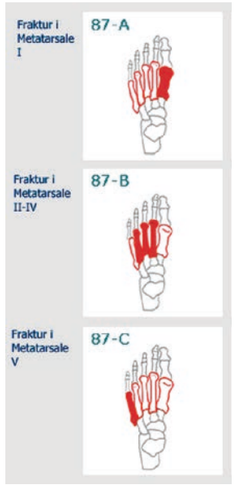
84 Cuboideumfrakturer



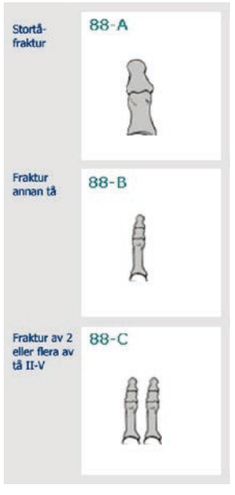
85 Cuneiformefrakturer inkl Lisfrancledsskador



87 Metatarsal-bensfrakturer



88 Tåfrakturer



Injury Codes

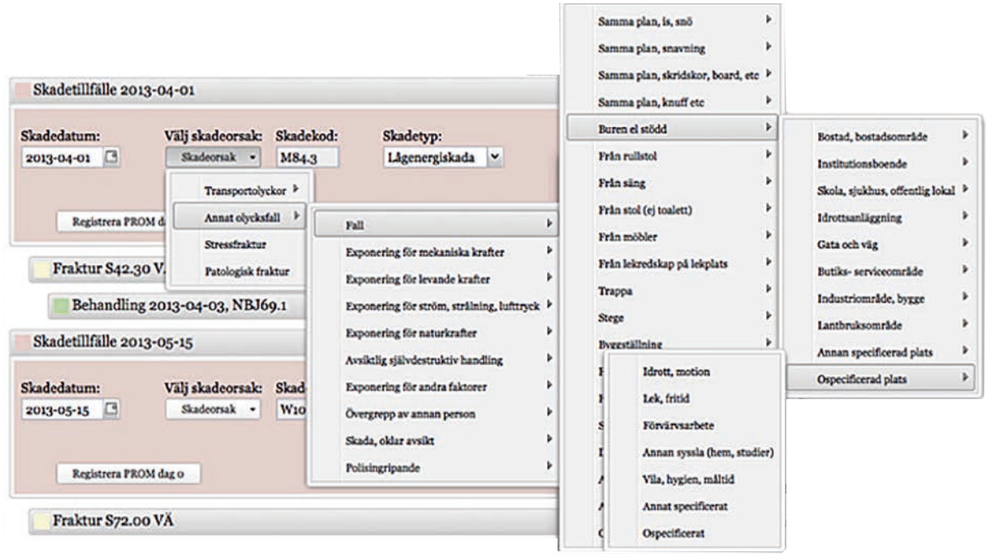
The cause of the injury is entered in accordance with the ICD-10 codes (V, W and X range) for external causes of illness and death.

Such data are unlikely to be particularly reliable when entered by healthcare professionals. Since entering such data is frequently difficult or time-consuming, accuracy tends to be compromised and a standard code is a common expedient. Correct description of an injury relies heavy on identifying the mechanism involved, particularly in view of the demands of future epidemiological research. Such entries in the SFR follow a simplified, structured procedure without sacrificing a single decimal point of accuracy. Only the codes of injuries that can cause fractures are included. The possible mechanisms are arranged hierarchically and chosen step-by-step from drop down menus. Our sense is that the system enables significantly faster identification of the correct injury code than other methods. Thus, SFR can be quite helpful in obtaining the correct code, even for the medical record system.

Fractures that do not have traumatic causes are captured under the choice between those that are pathological, stress or spontaneous.

The SFR has expanded the injury codes for traffic accidents from three places to a system able to make such distinctions as whether a bicycle collided with another one, a car, a bus, etc.

We have added a classification (an extra decimal place to the ordinary codes) that distinguishes between downhill, cross-country and roller skis, as well as roller skates and skateboards.



Diagnosis Codes

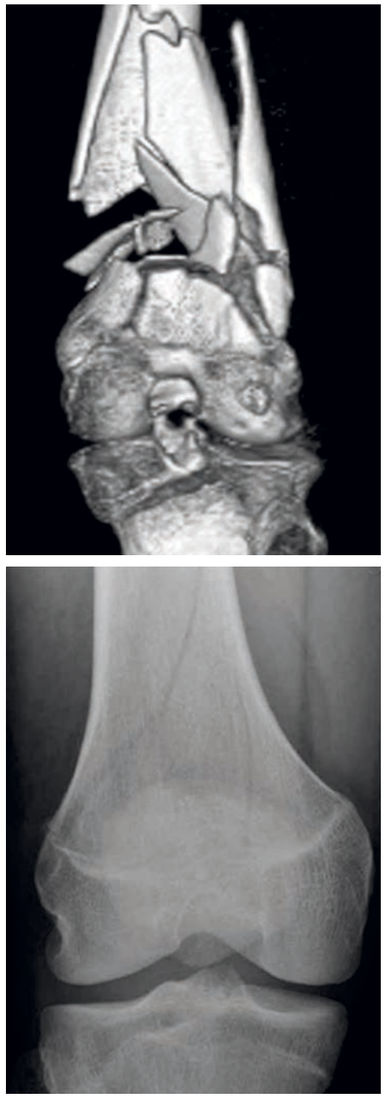
Entry of diagnostic codes is vital to the success of the SFR. We use two coding systems: ICD-10, which is also employed by medical record systems and other healthcare registers, and a more detailed system to describe the type (appearance) of the fracture. Most of the ICD-10 codes are in the S range designating new fractures, either open or closed. For some exceptional pelvic and metatarsal injuries, ICD-10 codes for ligament injuries that do not involve the skeleton are used, to better describe the nature of the injury.

Approximately one per cent of the fractures are not caused by injuries. The codes in the S range cannot be used in such cases. Most of these fractures involve stress fractures, pathological- or spontaneous fractures and, codes in the M range are generated when these types of fractures are entered.

Normally the ICD-10 code is generated when the user chooses a fracture type from the skeleton in the fracture panel. The fracture type, which correspond to a particular ICD-10 code, is specified along with the ICD code (and the side of the body). The ICD -10 code cannot be stored until the user indicates whether the fracture is open or closed.

To ensure a consistent link between the ICD-10 code and the type of fracture, the SFR adds an extra character to the customary code for particular fractures such as forearm, lower leg, ankle and foot.

The ICD codes for classification of fractures make a blunt instrument without any obvious value other than to specify which part of a bone that is involved. Since public information about fractures contains ICD-10 codes only, it is important to link the more detailed classifications in the SFR with the codes such that both of them are specified at the same time. For the orthopaedic specialist dictating for the patient chart, all the necessary codes are obtained by the SFR.



Two fractures with the same ICD-10 code can differ concerning difficulty and prognosis. Two distal femur fractures are presented above (ICD S72.4)

Procedure Codes

The third and last part of the SFR contains information about a specific intervention. The intervention is entered as soon as it is provided. Nonsurgical intervention can be entered along with other information at the emergency department when the injury is diagnosed. Surgical interventions are entered by the surgeon when completed.

The SFR uses the procedure codes, based on the 1997 Classification of Surgical Interventions (KKÅ97), that are common to Swedish healthcare practice. KKÅ97 is the Swedish version of NCSP96, the joint Nordic surgical coding system. Classification of healthcare interventions (KVÅ) is a combination of KKÅ97 and the nonsurgical intervention codes.

To facilitate entry and minimise the risk of erroneous input, the SFR displays only procedure codes that are applicable for the type of fracture in question. Any additional codes that are relevant to reoperation are displayed at that point.

In certain cases, the SFR adds an extra digit in the sixth or seventh place. The purpose is to increase the level of detail and generate information about the various types of interventions and implants. For examples, the codes for medullary nailing have been expanded to specify whether it is short or long, antegrade or retrograde. Similarly, a distinction is made between plate systems that are fundamentally different. In the not too distant future, it may be possible to enter individual implant components by means of bar codes. Such information is presumably less important in fracture surgery than in prosthesis surgery. On the other hand, being able to use the register to determine what type of plate or nail is involved would be of value even now.

The nonsurgical procedure codes have been simplified such that the same type of combinations are used regardless of fracture type. The only difference is the character that specifies the part of the skeleton that has sustained the injury to be immobilized. The same code is used for nonsurgical intervention whether it is with a cast, orthotic device or other dressing. The digits 0 or 1 are used to distinguish between closed reduction fractures and fractures treated without reduction.

Patient Reported Outcome Measures

The SFR uses the EQ-5D to measure health-related quality of life and the Short Musculoskeletal Function Assessment (SMFA) to measure functional status following treatment of various types of skeletal injuries. The outcome measures also capture complications and other more traditional endpoints because they collectively reflect both general health status and musculoskeletal function.

EQ-5D

Many orthopaedic quality registers use the EQ-5D. The instrument, which is not disease-specific, can be used in the general population to calculate and compare the costs of various interventions. The EQ-5D consists of five dimensions that permit the patient to describe perceived state of health in terms of mobility, hygiene, main activities, pain/discomfort and depression on a three-point scale. The total score ranges from 0 (death) to 1 (completely healthy).

SMFA

Most quality registers focus on a particular ailment for which disease-specific outcome measures (such as WOMAC or DASH) are suitable. Because the SFR includes patients with all different types of skeletal injuries, an instrument that is specific to one part of skeleton is not feasible. The SMFA was designed expressly for the purpose of studying differences among patients with a wide range of musculoskeletal diseases and injuries. The original American version (Swiontkowski et al., 1999) has been translated and validated to German, French, Swedish and other languages (SMFA-Swe, Ponzer et al, 2003). The SMFA provides a measure for studying function following various types of fractures in order to compare patients with a broad range of injuries and interventions. The American Academy of Orthopaedic Surgeons (AAOS) has also recommended SMFA as an suitable instrument.

The SMFA consists of 46 questions: 34 concern difficulties in performing certain activities (Dysfunction Index) and 12 concern discomfort and inconvenience (Bother Index). The Dysfunction Index measures the severity of the difficulties (25 questions), as well as their frequency (9 questions). The Bother index covers four areas: daily activities, emotional status, function of the extremities and mobility (5-point scale on which 1 corresponds to “no difficulty” and 5 corresponds to “totally unable”).

The Bother Index also ranges from 1 (“not bothered at all”) to 5 (“extremely bothered”). The final SMFA score is based on a descending scale from 0 to 100. The results are presented in six subscales.

As extensive as the SMFA might appear to be, it has worked well for both clinical studies and the SFR. The SFR will contribute extensive data for reference purposes in future studies and various clinical settings.

Administering questionnaires

Patients with an entry in the SFR are sent the EQ-5D and SMFA questionnaires shortly after having sustained a fracture. Most of them receive the questionnaires by post, while a few fill them out at hospital. An informative, explanatory cover letter accompanies the questionnaire. Information about the implications of being entered in a quality register and how to avoid it if so desired is also included in the mailing.

It is essential that the questionnaire is distributed within a few weeks after the injury for the patient to report prior function by the recall technique. One year later all previous respondents receive an identical questionnaire to allow evaluation of function and the extent to which the pre-injury state has been restored.

Each unit identifies the patients who have suffered fractures and sends them the questionnaires. The questionnaires are scanned into the register once they have been returned to the SFR. While costly, the centralised scanning necessary to relieve departments the onus of manual input.

A high response rate is vital to ensuring that distribution of the questionnaires to all patients actually makes a difference. The SFR engages in ongoing discussions with statisticians who are particularly skilful and interested in the area of PROMs. Studies are under way to determine why patients decline to respond and to identity any systematic patterns that may be involved.

To protect privacy, the specific details of the responses anonymous. Thus, individual users of the SFR can view only the various computed scores.

Whether or not patients filled out the questionnaire on their own was not entered in 2011–2012. But that information has been included since 2013. A note can be made to the effect that a family member, friend or caregiver participated.

The response rate among patients at Sahlgrenska University Hospital was measured in 2012. After one reminder, 65 per cent of the patients had responded, a gratifying figure for that particular patient population. Assuming that non-response is not systematic, the questionnaires can be highly valuable tools when the register contains a large volume of patients. The SFR’s internal validation instruments permit each centre to view the proportion of their patients who have returned the questionnaires. The proportion ranges from 45 to 65 per cent if the questionnaires are given to all patients, including those who have dementia or cannot read Swedish.

Eventually we should be able to design a simplified evaluation instrument or questionnaire that more specifically measures the variables of interest in the fracture population. That will be no simple task, but given the large number of questionnaires that have to be distributed, designing a shorter and more specific form could turn out to be of the utmost importance.

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Centre of Registers Västra Götaland provides a variety of services for the management and development of national quality registers and supports affiliated researchers. It is one of several Swedish register centres. It enables new registers to benefit from the experience accumulated by older ones and offers advanced expertise in the areas of statistics and information technology. The centre's development managers take charge of publishing its annual reports and coordinate support for the activities of the various registers.

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