

## Review

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# Diagnosis and therapy of osteoporosis in geriatric trauma patients: an update

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**Abstract:** Demographic changes confront clinicians with an increasing number of orthogeriatric patients. These patients present with comorbidities, which force their surgeons to take into consideration their medical condition. A major risk factor for fractures in orthogeriatric patients is osteoporosis in combination with frailty. To prevent subsequent fractures in these patients, we need to pay attention to adequate osteoporosis treatment in orthogeriatric patients. There is a huge treatment gap. In Germany, 77% of patients with osteoporosis are not treated adequately. Even after fragility fractures, a low percentage of patients receive a specific osteoporosis therapy. Secondary prevention is of great importance in the treatment of these patients. Diagnostics and treatment should be already initiated with the admission to the hospital. Treatment decisions need to be made individually based on the risk profile of the patients. After discharge, it is important to involve the patients' general practitioners and to follow up on patients regularly to improve their compliance and to ensure adequate therapy. Establishing a fracture liaison service helps coordinating osteoporosis treatment during hospitalization and after discharge. Subsequent fractures can be reduced; therefore, it is an effective service for secondary prevention. The present article provides an overview of how an efficient identification and subsequent treatment of osteoporosis can be achieved in aged trauma patients.

**Keywords:** fracture liaison service; hip fracture; orthogeriatric; osteoporosis; vitamin D.

## Background

Demographic changes confront clinicians with an increasing number of orthogeriatric patients. Aged trauma patients present with various comorbidities, and these have to be addressed to secure the results of surgical intervention. Thus, fractures associated with a low-energy trauma are frequently the first sign indicating an underlying osteoporosis [1, 2]. Given the high prevalence of osteoporosis in combination with frailty, patients are at a high risk for secondary fractures. Within 5 years after an osteoporotic index fracture, 14.7% of these patients suffer another hip fracture and 32.5% another osteoporotic fracture [3].

Thus, it is crucial to screen orthogeriatric patients for an underlying osteoporosis to initiate adequate therapy, adjust the surgical procedures, and prevent subsequent fractures in these patients.

## Epidemiology

In female patients older than 75 years, the prevalence of osteoporosis is 59.2% [4]. Approximately 6.3–7.8 million of German inhabitants are affected by osteoporosis [5]. However, there is a huge treatment gap, as 77% of these patients are not treated adequately [6]. Even after fragility fractures, only 16%–21% of female patients and 3.4% of male patients receive specific osteoporosis therapy [5, 7]. Given the high risk of secondary osteoporotic fractures, prevention is of great importance in the treatment of these patients.

## Identification

At a first glance, the identification of patients at risk of osteoporosis appears complicated. However, there are fractures such as thoracic and lumbar vertebral fractures, proximal femur fractures, proximal humerus fractures, and fractures of the distal radius in which the prevalence

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of an underlying osteoporosis remains high. Osteoporosis was diagnosed in 56.2% of women older than 50 years with fragility fractures and men ages 60 years [4]. Patients with typical osteoporosis-related fractures should be screened for osteoporosis [8].

According to the guidelines for osteoporosis by the Dachverband Osteologie e.V. (DVO) 2014, patients without any fracture should generally be assessed at the age of 70 years in women and at the age of 80 years in men; in high-risk patients, a clarification in younger age might already be useful [9].

When orthogeriatric patients with fractures are admitted to hospital, risk factors for osteoporosis should be assessed by standardized questionnaires. Thus, standardized questionnaires and algorithms based on the osteoporosis guidelines of the DVO 2014 for prevention, diagnostics, and treatment of osteoporosis [9] can help to estimate the risk of a secondary fracture (downloads available at <http://www.klinikum.uni-muenchen.de/Klinik-fuer-Allgemeine-Unfall-und-Wiederherstellungschirurgie/de/fach/alterstraumatologie/downloads/index.html>). Internationally acknowledged to identify the osteoporosis-associated fracture risk are the FRAX- or Q-factor score [10, 11]. A diagnostic assessment in postmenopausal women and men older than 60 years is recommended as soon as a fragility fracture or an increased risk of fractures is present [12].

## Osteoporosis diagnostics

The new guidelines of the DVO 2014 recommend five diagnostic steps to confirm the diagnosis of osteoporosis.

Taking the medical history should already identify risk factors for osteoporosis as mentioned above. The following subjects are important to include in the medical history: tendency to fall, medication (especially glucocorticoids, aromatase inhibitors, and the long-term intake of proton pump inhibitors, which are a potential risk factor still under discussion), and preexisting conditions such as diabetes mellitus, ankylosing spondylitis, chronic obstructive pulmonary disease (COPD), and endocrine disorders (such as hypothyroidism).

Also, a detailed clinical examination helps finding indicators for osteoporosis. Especially, the Tannenbaum phenomenon is common. In addition, a loss of height over 2 cm may indicate further diagnostics [13].

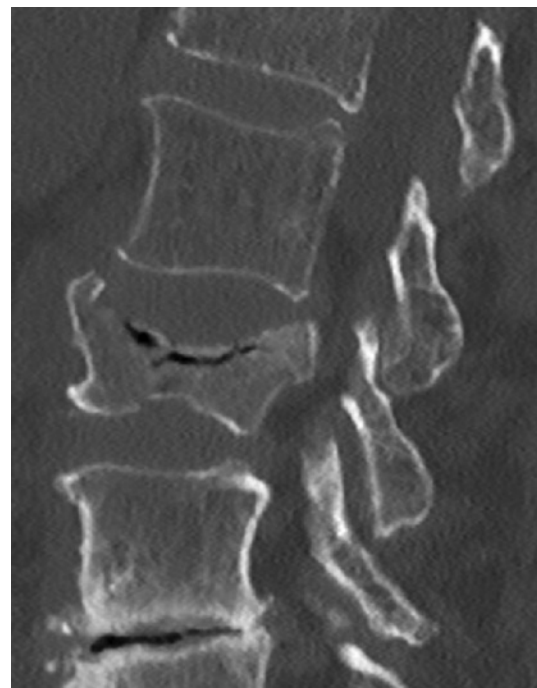
A basic blood testing consists of calcium and phosphate in serum, alkaline phosphatase,  $\gamma$ -glutamyl-transferase ( $\gamma$ -GT), creatinine, C-reactive protein (CRP),

thyroid-stimulating hormone (TSH), 25-OH-vitamin D3, a serum electrophoresis, and a complete blood count.

Dual X-ray absorptiometry (DXA) is the gold standard to determine bone density. Radiation exposure and costs are relatively small [8]. The lower bone density is, the higher is the risk for osteoporotic fractures [14]. Density measurements of the lumbar spine, femur, and femoral neck are set in relation to bone density values of a normal population (T-value). Treatment is based on the t-value, age of patients, and the individual risk factors. Risk factors, such as glucocorticoid therapy or multiple fractures in the past 3 years, increase the treatment threshold.

According to the DVO 2014 [9], in some cases, bone density scans are not necessary to obtain the diagnosis of an underlying osteoporosis. Thus, in patients having suffered a fragility fracture that shows radiographic signs of an osteoporosis within the spine or proximal femur (i.e. Figures 1 or 2), an underlying osteoporosis can be diagnosed without bone density measurements. Also, multiple low-graded fractures of the vertebral spine, such as a singular grade II impression of the vertebrae according to the Genant classification, go in line with an underlying osteoporosis (Figure 1) [15].

Degenerative changes (i.e. of the spine) can increase the t-value. If, in these cases, bone density scans of the



**Figure 1:** Preoperative CT scan with an atraumatic lumbar vertebral fracture.

In this case, the diagnosis of an underlying osteoporosis can be secured without further bone density scans.



**Figure 2:** Preoperative X-ray with a pertrochanteric fracture of the proximal femur on the left side.

hip cannot be applied, quantitative computed tomography (CT) scans are recommended [16, 17].

## Osteoporosis treatment

Vitamin D deficiency is widely spread among elderly patients. It is associated with muscle weakness and therefore with a tendency to fall. Aged trauma patients are at high risk to develop vitamin D deficiency because of malnutrition, reduced sunlight exposure, impaired intestinal absorption, and impaired hydroxylation in the liver and kidneys [18]. In elderly patients with hip fractures, only approximately 10% of the patients have an adequate vitamin D level [19].

Treatment algorithms can be helpful for the decision of the individual osteoporosis therapy (Figure 3).

Basic treatment aims on a compensation of vitamin D level and a sufficient calcium intake. A balanced calcium homeostasis is required for the initiation of a specific osteoporosis treatment and crucial to secure fracture healing [20].

According to the DVO guidelines, a dose of approximately 1000 IU/day vitamin D is needed to maintain a normal to high vitamin D level. Vitamin D application should be adjusted to the laboratory results (Table 1). A 25-OH-vitamin D level above 75 µg/L is not recommended, as it has been shown to be associated with an increased risk of falls [21].

The intake of calcium should be up to 1000 mg/day. Raising the calcium level can be achieved through diet, for example, with calcium-rich mineral water (about 400 mg/L) or dairy products such as milk, cheese, cottage cheese, or yogurt. During a therapy with glucocorticoids,

calcium supplements with a dose of 1000 mg/day calcium are recommended.

As supplement, calcium carbonate is recommended. However, a high percentage of elderly patients have proton pump inhibitors among their daily medication. In these patients, calcium citrate or calcium gluconate is recommended for an adequate resorption of calcium [22].

Depending on laboratory findings, specific therapy can be initiated during hospitalization. Considering contraindications and comorbidities, a specialized physician should initiate specific therapy.

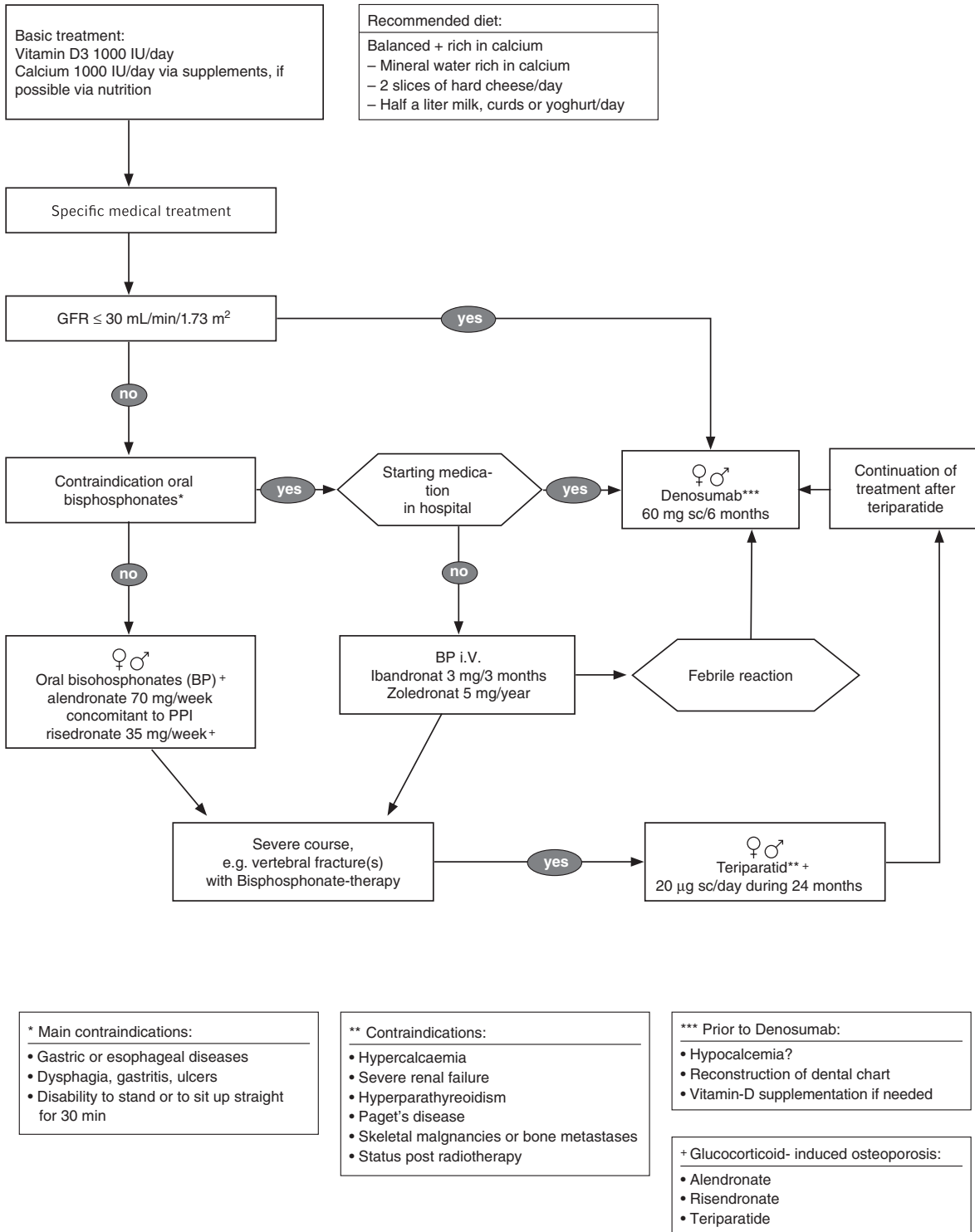
Oral bisphosphonates are the first-line medication in postmenopausal osteoporosis. In patients older than 75 years, alendronate and risedronate show a reduced risk for vertebral fractures [23]. Also, intravenously applied bisphosphonates such as ibandronate or zoledronate show a reduction of vertebral fractures and zoledronate also decreases the total fracture risk.

An intravenous therapy with bisphosphonates should not be started before 14 days after surgery to prevent accumulation around the internal fixation [24]. To avoid hypocalcemia, vitamin D levels should be normal before starting with a specific osteoporosis therapy. In some cases, an intravenous bisphosphonate therapy is recommended 6 weeks after fracture.

Studies show that intravenous therapy with bisphosphonates is not inferior to the therapy with oral bisphosphonates concerning fracture risk. The compliance of the patients might be even higher in monthly intravenous applications than in taking it orally [25, 26].

The osteoanabolic therapy with recombinant parathyroid hormone (teriparatide) is effective but costly. It can be an option when, despite adequate pretreatment, osteoporosis progresses or causes further vertebral fractures. Teriparatide received the recommendation level B of the DVO due to the superior effect compared to alendronate in treating glucocorticoid-induced osteoporosis and reducing peripheral postmenopausal osteoporotic fractures [27].

Depending on the risk profile of the patient, monoclonal antibodies, such as denosumab, are also considered as an option. Studies with denosumab show a reduction of vertebral fractures and peripheral fractures such as proximal femur fractures. Especially, in orthogeriatric patients with limited compliance associated with cognitive disorders such as dementia or patients who refuse taking more oral medication, denosumab offers advantages. Thus, a specific osteoporosis therapy with denosumab, which has to be applied only twice a year, can be secured easily, as it is injected subcutaneously, which could be handled, for example, by the



**\* Main contraindications:**

- Gastric or esophageal diseases
- Dysphagia, gastritis, ulcers
- Disability to stand or to sit up straight for 30 min

**\*\* Contraindications:**

- Hypercalcaemia
- Severe renal failure
- Hyperparathyroidism
- Paget's disease
- Skeletal malignancies or bone metastases
- Status post radiotherapy

**\*\*\* Prior to Denosumab:**

- Hypocalcaemia?
- Reconstruction of dental chart
- Vitamin-D supplementation if needed

**+ Glucocorticoid- induced osteoporosis:**

- Alendronate
- Risedronate
- Teriparatide

Figure 3: LMU algorithm for the treatment of osteoporosis.

nursing staff and monitored by their general practitioners [28–30].

Due to the increased risk of thrombosis, strontium ranelate, selective estrogen receptor modulators (SERMs; raloxifene and bazedoxifene), and estrogens (optionally

in combination with a progestin) are not suitable for orthogeriatric patients [10, 31].

Calcitonin plays no role in first-line therapy. Only in cases with severe renal insufficiency, it might be applied because other agents are contraindicated.

**Table 1:** Vitamin D3 levels and treatment recommendations adapted from Amling [20].

	25-OH-vitamin D3 level, mg/L	Cholecalciferol	Comments
Severe deficiency	< 10	20,000 IU/day for 10 days then 20,000 IE/week	Additional tests for calcium metabolism
Distinct deficiency	10–20	20,000 IU/day for 5 days then 20,000 IE/week	Follow up after 2–3 months
Deficiency	21–30	20,000 IU/week	Follow up after 2–3 months
Optimal level	31–60	1000–2000 IU/day	Maintain level
Oversupply	> 100	Pause therapy	Addressing causes

## Prevention

An effective prevention of subsequent fractures includes also fall prevention with muscle training, physiotherapy, and critical adjustment of the preexisting medication.

Training should concentrate on an integration of general movement, improvement of coordination, balance, posture, and flexibility [32].

Medication, which causes vertigo or dizziness, should be reduced [33]. Also, medication that reduces bone quality (e.g. glucocorticoids) or bone healing [e.g. non-steroidal antirheumatics (NSAR)] should be avoided.

A big problem is also the compliance of these elderly patients. The literature shows that the percentage of compliant patients decreases to 50% over a period of 1 year after initiation of treatment and even to only 30% over time [34]. Women and patients with DXA were more likely to follow their doctors' instructions, whereas older or multimorbid patients and those with a preexisting high amount of medications are more likely to not continue with their medication.

Secondary prevention via fracture liaison service (FLS) is another additional organization to comanagement to reduce subsequent fractures and postoperative complications. First mentioned in 1999, the "UK National Health Service" in Glasgow, Scotland, established one of the first FLS. Today, clinics can apply to certify through the International Osteoporosis Foundation (IOF) for FLS.

A specially trained fragility fracture nurse is taking care of the coordination of the patients' treatment after admission to the hospital. Besides identifying patients of high risk and initiation of adequate diagnostics and osteoporosis therapy, the fragility fracture nurse is also monitoring the patients' compliance after discharge.

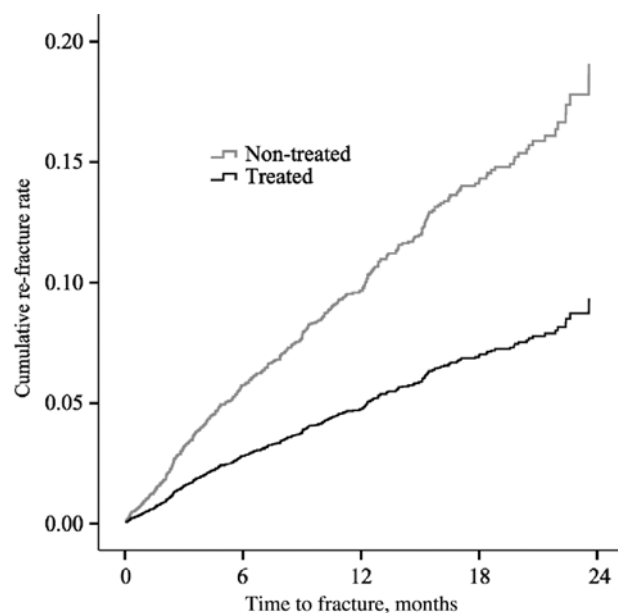
This network also increases compliance by close supervision in rehabilitation and outpatient clinics [35, 36].

The rate of subsequent fractures in patients with untreated osteoporosis increases significantly within the first 2 years after the first fracture [37]. Patients with fragility fractures have an increased risk of 86% for subsequent

fractures [38]. In patients with vertebral fractures, the risk of another fracture is doubled and after proximal femur fractures even trebled [39]. Recent studies show that establishing an FLS can reduce subsequent fractures by approximately 30%. Axelsson et al. stated that even a minimal resource FLS was effective in increasing investigation and treatment (Figure 4). Patients treated in an FLS setting had a re-fracture risk reduction of 51%. This indicates that an FLS can improve secondary prevention of fractures [40, 41].

To prevent one re-fracture in 3 years, the number needed to treat (NNT) with FLS is 20 [42]. For the widely spread angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs), the NNT is 80 and 338 over a period of 4.3 years to prevent one myocardial infarction.

Allowing an early initiation of appropriate treatment, the rate of subsequent fracture can be significantly reduced [41, 43]. Another positive effect lays in the reduction of



**Figure 4:** Re-fracture rate with and without treatment of osteoporosis in an FLS setting from 2011 to 2014 [40].

health economic cost [44, 45]. The literature shows that introducing an orthogeriatrician-led or a nurse-led FLS is cost-effective compared to usual care.

## Conclusion

The management of orthogeriatric patients should not only focus on the surgical aspects of treatment but also include diagnosis and treatment of an underlying osteoporosis. Decisions should be based on the risk profile of the patients. Treatment is more complicated because of comorbidities limiting the therapy options. It is also difficult to convince these patients to follow through with their therapy even if they have already reached a high age. Therefore, it is important to involve their general practitioners and the patients themselves as an attempt to increase compliance. Thus, precise patient information about their therapy and risk of subsequent fractures is of importance. Especially, aged trauma patients tend to concentrate on their return to daily activities following fracture and neglect the necessity of osteoporosis therapy. Therefore, it is important to follow up on these patients and secure secondary fracture prevention.

FLS is a new approach that can significantly increase the efficiency of osteoporosis treatment by coordinating osteoporosis treatment during hospitalization and after discharge. It helps avoiding subsequent fractures and therefore is an effective service to secure secondary fracture prevention.

### Author Statement

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### Author Contributions

Deborah Schray: writing of the manuscript. Ulla Stumpf: approval of the manuscript. Christian Kammerlander: approval of the manuscript. Wolfgang Böcker: approval of the manuscript. Carl Neuerburg: revision of the manuscript.

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**Supplemental Material:** The article (DOI: 10.1515/iss-2016-0028) offers reviewer assessments as supplementary material.

## Reviewer Assessment

## Open Access

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## Reviewers' Comments to Original Submission

### Reviewer 1: Carsten Schöneberg

Nov 09, 2016

<b>Reviewer Recommendation Term:</b>	<b>Accept with Minor Revision</b>
<b>Overall Reviewer Manuscript Rating:</b>	<b>64</b>
<b>Custom Review Questions</b>	Response
Is the subject area appropriate for you?	4
Does the title clearly reflect the paper's content?	5 - High/Yes
Does the abstract clearly reflect the paper's content?	5 - High/Yes
Do the keywords clearly reflect the paper's content?	3
Does the introduction present the problem clearly?	4
Are the results/conclusions justified?	4
How comprehensive and up-to-date is the subject matter presented?	4
How adequate is the data presentation?	4
Are units and terminology used correctly?	3
Is the number of cases adequate?	N/A
Are the experimental methods/clinical studies adequate?	N/A
Is the length appropriate in relation to the content?	4
Does the reader get new insights from the article?	4
Please rate the practical significance.	5 - High/Yes
Please rate the accuracy of methods.	N/A
Please rate the statistical evaluation and quality control.	N/A
Please rate the appropriateness of the figures and tables.	3
Please rate the appropriateness of the references.	4
Please evaluate the writing style and use of language.	3
Please judge the overall scientific quality of the manuscript.	4
Are you willing to review the revision of this manuscript?	Yes
<b>Comments to Authors:</b>	



Dear Authors,  
 your Article „Diagnostic and therapy of osteoporosis in geriatric Trauma patients“ presents a really good overview in a Topic, which is very important already and will me even more important in the future. I believe, your article will help Trauma surgeons, who are involved in the Treatment of geriatric Trauma patients. Osteoporosis is one of the Major Problems in patients healthcare, especially in Trauma surgery.

Nevertheless, I have some minor Points for Revision:

- Abstract: FLS appears for the first time. Therefore it has to be written in full length
- Osteoporosis diagsnotics; Line 56: Some in vitro studies reported, that there was no adversed effect of PPI on human osteoblasts (Prause, M et al. Injury 2014; Prause, M et al. Mediators inflamm 2015). Therefore it remains unclear, if PPI are associated with a higher fracture risk.
- Figure 3: There are two speech bubbles. I can't find any Information in them.
- Figure 3: One box is written in German
- Site 10 Line 192: ...Treatment an even; does it mean:... Treatment and even
- Site 10 Line 197,198: The Fracture Liaison Service.... This is a final Statement. You should not start your paragraph about FLS with a final Statement. This should be at the end.

In General:

- Was the manuscript reviewed by a native Speaker? It might benefit from language Support.
- All figures and tables are not cited in the text. It is important to cite them in the text.
- Our patients might benefit from a FLS. In Germany, such a Service is not paid by the public health insurance, currently. I think, this is another great Problem. Who has to pay the costs of secondary prevention?
- Your presented algorithm for Treatment of osteoporosis is really impressive. I think in a Center for geriatric Trauma with geriatricians, such a algorithm is very good. But in a Standard Trauma department without geriatric Support, i think there are some risks like contraindications, medical interactions ect. Basic Treatment with Vitamin D and Calcium is no Problem and should be started, when osteoporosis is diagnosed. But Specific medical treatment should be given by specialized physicians. In our „Alterstraumazentrum“ we have defined that in this way.
- Patients with distal radius fractures are usually hospitalized for only one or two days. Therefore we have to built Networks, to treat their osteoporosis. In These cases the time is to short for your algorithm

**Reviewer 2: Peter Giannoudis**

Nov 28, 2016

<b>Reviewer Recommendation Term:</b>	Revise with Major Modifications
<b>Overall Reviewer Manuscript Rating:</b>	70
<b>Custom Review Questions</b>	<b>Response</b>
Is the subject area appropriate for you?	5 - High/Yes
Does the title clearly reflect the paper's content?	3
Does the abstract clearly reflect the paper's content?	3
Do the keywords clearly reflect the paper's content?	4
Does the introduction present the problem clearly?	3
Are the results/conclusions justified?	3
How comprehensive and up-to-date is the subject matter presented?	4
How adequate is the data presentation?	3
Are units and terminology used correctly?	5 - High/Yes
Is the number of cases adequate?	N/A
Are the experimental methods/clinical studies adequate?	N/A
Is the length appropriate in relation to the content?	3
Does the reader get new insights from the article?	3
Please rate the practical significance.	4
Please rate the accuracy of methods.	3
Please rate the statistical evaluation and quality control.	N/A
Please rate the appropriateness of the figures and tables.	3
Please rate the appropriateness of the references.	4
Please evaluate the writing style and use of language.	2
Please judge the overall scientific quality of the manuscript.	3
Are you willing to review the revision of this manuscript?	Yes
<b>Comments to Authors:</b>	

This is an interesting article. The topic is relevant. However, the manuscript can be improved further by:

1. The language being checked by a native English speaker.
2. Title should be revised
3. Back ground: further information is required i.e.: (that usually the underlying osteoporosis condition is overlooked. There are issues not only how to fix the fractures because of the compromised bone but also to ensure that we can influence prevention of further fractures.. Appropriate references must be used).
4. A special paragraph should be inserted to address the fact that 30-40% of elderly patients admitted are with dementia. Specific instructions as to how these patients should be assessed and managed should be included.
5. Please see below some comments:

Title: Diagnostic and therapy of osteoporosis in geriatric trauma patients

Revise to: Diagnosis and treatment of osteoporosis in geriatric trauma patients: An update

Sentence 5:.... These patients present with comorbidities, which forces their surgeons to take into consideration their medical condition.

Sentence 14: However, there is a huge treatment gap as 77% of these patients are not treated adequately (3).

Sentence 23: At a first glance, the identification of patients at risk of osteoporosis appears complicated.

Sentence 41:..... (7) help estimating the fracture risk. These algorithms can be accessed on our 42 homepage (8).

Please move reference 8 next to 7 to read as follows:..... (7, 8) help estimating the fracture risk.

Sentence 60: Especially the Tannenbaum phenomenon is an indicator of bone loss and also a loss of height more than 2cm may indicate further diagnostics. Please insert reference.

Sentence 68:... The lower bone density the higher is the risk for osteoporotic fractures (13).

Should be: The lower the bone density is the higher would be the risk for osteoporotic fractures (13).

Sentence 74-75: .... According to the DVO guideline 2014 (7) patients having suffered a trochanteric fracture which is suspicious for an osteoporosis given the radiographic...

Should be: According to the DVO guideline 2014 (7) patients having suffered a trochanteric fracture which is suspicious for osteoporosis given the radiographic...

Sentence 76: ....which is associated with a low energy trauma no further bone density

Should be: ...which is associated with a low energy trauma no bone density...

Sentence 79:.... Genant classification go inline Please insert reference.

Sentence 105: Title: Treatment of osteoporosis in stationary trauma

Comment: Stationary trauma not appropriate word!! You mean following low velocity trauma?

Sentence 170: ..Their general practitioners can monitor patients with dementia or patients who refuse taking more oral medication, application is only necessary twice a year (25-27).

Revise to: Patient with dementia or patients who refuse taking more oral medication can be monitored by their general practitioners, application is only necessary twice a year.

Sentence 192:..... an even to only 30% over time (29).

Revise ...and even to only 30% over time (29).

Sentence 243: Orthogeriatric patients challenge their physicians to include their special needs in the treatment. It is important to not only concentrate on the surgical treatment but to address osteoporosis its diagnostic and its treatment especially to avoid subsequent fractures.

Revise: Management of Orthogeriatric patients not only should be focused on the surgical aspects of treatment but also should include diagnosis and treatment of the underlying osteoporosis

Please revise and resubmit.

## Authors' Response to Reviewer Comments

Dec 05, 2016

Dear Reviewers,

The authors would like to thank you for having reviewed our manuscript "Diagnosis and therapy of osteoporosis in geriatric trauma patients: An update".

We appreciate the additional perspective that you provided.

We appreciate the comments of all Reviewers and we tried to integrate your suggestions in our article.

Please find below our responses to the Reviewers' comments. Changes to the manuscript have been made according to the Reviewers' suggestions and are highlighted using "Track Changes".

The manuscript was checked by a native speaker with regards to language editing.

Ad Reviewer #1:

Osteoporosis diagnostics; Line 56: Some in vitro studies reported, that there was no adverse effect of PPI on human osteoblasts (Prause, M et al. Injury 2014; Prause, M et al. Mediators Inflamm 2015). Therefore it remains unclear, if PPI are associated with a higher fracture risk.

Response:

Literature shows differing conclusions, but a number of studies are showing consistent results that support the conclusion that there might be long-term adverse effects. You are right it remains unclear, but PPI prescriptions are high in this age group and should at least be reconsidered.

Our patients might benefit from a FLS. In Germany, such a Service is not paid by the public health insurance, currently. I think, this is another great Problem. Who has to pay the costs of secondary prevention?

Response:

This is an interesting aspect. The focus of public health insurance is slowly shifting towards prevention. Small hospitals might have problems organizing and financing an FLS. Future models of an integrated care or Best practice tariffs might serve as an incentive for improved secondary fracture prevention. Yet, we refrained from stressing the financial burden of the FLS within the manuscript to avoid confusion. However, monitoring of these patients should be integrated in general checkups and surgical follow-ups.

Your presented algorithm for Treatment of osteoporosis is really impressive. I think in a Center for geriatric Trauma with geriatricians, such a algorithm is very good. But in a Standard Trauma department without geriatric Support, I think there are some risks like contraindications, medical interactions ect. Basic Treatment with Vitamin D and Calcium is no Problem and should be started, when osteoporosis is diagnosed. But Specific medical treatment should be given by specialized physicians. In our "Alterstraumazentrum" we have defined that in this way.

Patients with distal radius fractures are usually hospitalized for only one or two days. Therefore we have to build Networks, to treat their osteoporosis. In These cases the time is too short for your algorithm.

Response:

This is an important aspect that you are mentioning. In our center, the fragility fracture nurse and a geriatrician monitor the treatment of our patients. Therapy is initiated during the hospital stay or during close follow-ups at our outpatient clinic. A recommendation for adequate medication is mentioned in our discharge letter. It is important to raise patients' awareness for osteoporosis, to start with basic medication and to follow up in order to adjust the current medication and add specific medication.

We start our algorithm with the patient's admission to our hospital and depending on their stay we add recommendations for diagnostics

or adequate medication to our discharge letter. We also suggest appointments to follow up. In order to monitor these patients closely we need to establish networks that improve the compliance of these patients.

Ad Reviewer #2:

A special paragraph should be inserted to address the fact that 30-40% of elderly patients admitted are with dementia. Specific instructions as to how these patients should be assessed and managed should be included.

Response:

You are absolutely right. We tried to integrate treatment advices in our article, especially concerning the intake of medication. Patients with dementia are more likely to fall and suffer subsequent fractures, therefore it is important to treat osteoporosis adequately. Daily intake of medication is difficult; we therefore recommend medication that is only applied monthly or twice a year. In order to monitor these patients a close network with their family doctors is very important. As an attempt to indicate the problem of cognitive disorders alternative osteoporosis treatment was mentioned within the manuscript.

Thank you for your review and your consideration to publish our article in Innovative Surgical Sciences.

Sincerely,  
The authors

## Reviewers' Comments to Revision

### Reviewer 1: Carsten Schöneberg

Dec 07, 2016

<b>Reviewer Recommendation Term:</b>	Accept
<b>Overall Reviewer Manuscript Rating:</b>	65
<b>Custom Review Questions</b>	<b>Response</b>
Is the subject area appropriate for you?	4
Does the title clearly reflect the paper's content?	5 - High/Yes
Does the abstract clearly reflect the paper's content?	5 - High/Yes
Do the keywords clearly reflect the paper's content?	3
Does the introduction present the problem clearly?	4
Are the results/conclusions justified?	4
How comprehensive and up-to-date is the subject matter presented?	4
How adequate is the data presentation?	4
Are units and terminology used correctly?	3
Is the number of cases adequate?	N/A
Are the experimental methods/clinical studies adequate?	N/A
Is the length appropriate in relation to the content?	4
Does the reader get new insights from the article?	4
Please rate the practical significance.	5 - High/Yes
Please rate the accuracy of methods.	N/A
Please rate the statistical evaluation and quality control.	N/A
Please rate the appropriateness of the figures and tables.	4
Please rate the appropriateness of the references.	4
Please evaluate the writing style and use of language.	4
Please judge the overall scientific quality of the manuscript.	4
Are you willing to review the revision of this manuscript?	Yes
<b>Comments to Authors:</b>	
Dear Authors, the manuscript benefits from the changes you made. Now, i can accept the manuscript for publication.	

**Reviewer 2: Peter Giannoudis**

Dec 06, 2016

<b>Reviewer Recommendation Term:</b>	Accept
<b>Overall Reviewer Manuscript Rating:</b>	80
<b>Custom Review Questions</b>	<b>Response</b>
Is the subject area appropriate for you?	5 - High/Yes
Does the title clearly reflect the paper's content?	5 - High/Yes
Does the abstract clearly reflect the paper's content?	4
Do the keywords clearly reflect the paper's content?	5 - High/Yes
Does the introduction present the problem clearly?	4
Are the results/conclusions justified?	4
How comprehensive and up-to-date is the subject matter presented?	4
How adequate is the data presentation?	4
Are units and terminology used correctly?	5 - High/Yes
Is the number of cases adequate?	N/A
Are the experimental methods/clinical studies adequate?	N/A
Is the length appropriate in relation to the content?	4
Does the reader get new insights from the article?	4
Please rate the practical significance.	5 - High/Yes
Please rate the accuracy of methods.	4
Please rate the statistical evaluation and quality control.	N/A
Please rate the appropriateness of the figures and tables.	4
Please rate the appropriateness of the references.	5 - High/Yes
Please evaluate the writing style and use of language.	4
Please judge the overall scientific quality of the manuscript.	4
Are you willing to review the revision of this manuscript?	Yes
<b>Comments to Authors:</b>	
There revised paper has been improved. It reads better. It can be accepted now.	