



## Research Article

# Impact of Dementia on Treatment of Peripheral Arterial Disease, Hip and Vertebral Bone Fracture

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### Abstract

**Objectives:** We hypothesize that dementia impacts treatment strategy in cases hospitalized for advanced Peripheral Arterial Disease (PAD), Hip Fracture (HF) and Vertebral Bone Fracture (VF) in Germany. **Patients and Methods:** Detailed lists of cases hospitalized with the principal diagnosis PAD, HF and VF in the year 2019 were provided by the Federal Statistical Office. In addition, cases were separated by the additional diagnosis dementia and surgical treatment procedures. **Results:** In 2019, there were 166,244 cases hospitalized for HF, 69,888 with VF and 74,910 with PAD. The rate of cases with the additional diagnosis dementia were 18.2%, 7.7% and 7.1%. In HF cases most frequent surgical treatment was hip arthroplasty in both, cases with (37%) and cases without dementia (34%). In VF cases conservative treatment was the dominant treatment strategy with 70% in those without and 81% in those with dementia. In PAD cases conservative treatment was the dominant treatment strategy with 74% in those without and 67% in those with dementia. Major amputation (7% vs 14%) was performed more frequently in those with dementia, but not minor amputation (19% vs 19%). **Conclusion:** Our analysis supports the hypothesis, that dementia impacts treatment decisions in older patients suffering from HF, VF and PAD in Germany in different ways. In cases with dementia more cases with VF were treated conservatively and in case of HF more cases surgically. In cases with advanced PAD more major amputations were performed.

**Keywords:** Dementia; Peripheral arterial disease; Hip fracture; Vertebral bone fracture

### Introduction

Dementia is a condition characterized by cognitive decline affecting memory and at least one of the other neurocognitive domains, including personality, praxis, abstract thinking, language, executive functions, complex attention, social skills, and visuospatial skills. In addition to the deterioration noted, the severity must be such that daily functioning is impaired [1,2]. It is often a progressive disorder, and those affected often have no insight into their deficits. Currently, there is no cure for any of the causes of dementia. As treatment, outcomes for diseases such as cancer improve and life expectancy increases, the incidence and

prevalence of dementia is expected to continue to increase.

Typical conditions associated with dementia include hip fractures [4-9] and Peripheral Arterial Disease (PAD) [10-16]. Dementia increases the risk of Hip Fracture (HF) [17-19]. In a study comparing patients aged 65 to 90 years from 1072 primary care practices diagnosed with dementia with matched controls between 2010 and 2013, a total of 5.3% of patients and 0.7% of controls were found to have HF after 3 years [17]. A population-based retrospective cohort study of adults aged  $\geq 65$  years hospitalized with HF between 2007 and 2017 in New South Wales, Australia, reported that HF hospitalization rates were 2.5 times higher in adults with dementia compared with adults without dementia [18]. Data from the Korean National Health Insurance Service-National Sample Cohort, collected for the population  $\geq 60$  years of age from

2002 to 2013, found higher Odds Ratios (ORs) for dementia in the group with HF and Vertebral Fracture (VF) than in the group without fracture [20]. Data from the Honolulu-Asia Aging Study (HAAS), a prospective community-based study of 3734 Japanese-American men aged 71 to 93 years at baseline in 1991 to 1993, showed that low ABI was associated with a twofold increased risk of dementia [21]. A recent systematic review evaluating published data on undiagnosed cognitive impairment in patients with PAD found that patients with PAD were more likely to have undiagnosed cognitive impairment than healthy controls [22]. We previously analyzed dementia rates associated with various surgical procedures in 2012 [23]. From 2008 to 2010, dementia was documented as an additional diagnosis in 6% of cases with a principal diagnosis of PAD, but in approximately 18% of cases that received a major amputation.

Different jurisdictions may have different laws regarding the powers of appointed surrogates/powers of attorney/representatives. Dementia does not automatically preclude mental capacity - it depends on what is being asked. For example, a person with dementia can decide for themselves what to have for lunch, but is not able to consent to complex surgery. Between these examples, there are others that are more nuanced and need to be assessed for each individual. In patients with very severe dementia, decisions are almost always made with the surrogate decision maker due to the patient's incapacity. It is the physician's responsibility to inquire about and understand the patient's previously stated goals and values and then to guide and facilitate medical decisions so that the treatments offered are consistent with those goals and values [24,25].

We hypothesized that patients with dementia who are admitted to a hospital for acute treatment will be treated differently than patients without dementia. Therefore, we analyzed the surgical treatment of patients with Hip Fractures (HF), Vertebral Fractures (VF), or Advanced Peripheral Arterial Disease (PAVD) separately for the additional diagnosis of dementia. These three entities were selected because they are common in older people with dementia.

## Patients and Methods

### Nationwide hospitalization data

The Diagnosis-Related Groups Statistic (DRG) is an annual complete survey of all hospital cases in Germany that were accounted for by case rates. The microdata can be requested via the RDC starting from the survey year 2005. All hospitals in Germany annually transfer their individual hospitalization data, including one primary diagnosis, up to 89 secondary diagnoses coded by ICD-10 (International Classification of Diseases, 10th edition), and up to 100 medical procedures according to a national classification of operations and procedures to the Institute for the Hospital Remuneration System (InEK). After a plausibility control, the InEK forwards anonymized data to the Federal Bureau of Statistics. Principles of the analysis of this hospitalization file have been published several times previously [26,27]. In brief, we ask the Federal Bureau of Statistics to identify all hospitalizations of the year 2019 that have a principal diagnosis of PAD with ulcer or gangrene, HF and VF by calendar year, sex and 5-year age group. In addition, we ask for all cases for surgical treatment procedures. Finally, we received a defined data set from the Federal Bureau of Statistics including this information from all fully reimbursed inpatient cases (Tables 1-3). For this analysis we include all cases 50 years and older.

ICD code / Definition	n	OPS code / Definition	n
<b>S72.0 Fracture of unspecified part of neck of femur</b>			
All	80,049	5-820, total endoprosthesis	55,831
		7-790, CRIF	8,103
		7-793/4, ORIF	4,250
With dementia	14,255	5-820, total endoprosthesis	10,947
		7-790, ORIF	873
		7-793/4, CRIF	587
<b>S72.1 Pertrochanteric fracture of femur</b>			
All	72,771	5-820, total endoprosthesis	1,528
		7-790.0, ORIF	47,946
		7-790.3/4, CRIF	10,293
With dementia	13,883	5-820, total endoprosthesis	278
		7-790.0, ORIF	9,863

		7-790.3/4, CRIF	1,812
<b>S72.2 Subtrochanteric fracture of femur</b>			
All	13,424	5-820, total endoprosthesis	268
		7-790.0, ORIF	4,139
		7-790.3/4, CRIF	5,545
With dementia	2,108	5-820, total endoprosthesis	41
		7-790.0, ORIF	748
		7-790.3/4, CRIF	829

**Table 1:** ICD and OPS codes used for definition of cases with fracture of the femur neck and number of included cases. (ORIF: Open Reduction and Internal Fixation, CRIF: Closed Reduction and Internal Fixation).

ICD code / Defintion	n	OPS code /Definition	n
<b>S22 Fracture of thoracic vertebra</b>			
All	24,763	5-386, spinal fusion	1,245
		5-839.a, kyphoplasty	5,121
		5-839.9, vertebroplasty	570
Dementia	1,873	5-386, spinal fusion	36
		5-839.a, kyphoplasty	245
		5-839.9, vertebroplasty	33
<b>S32 Fracture of lumbar vertebra</b>			
All	43,474	5-386, spinal fusion	2,126
		5-839.a, kyphoplasty	10,334
		5-839.9, vertebroplasty	1,017
Dementia	2,659	5-386, spinal fusion	62
		5-839.a, kyphoplasty	548
		5-839.9, vertebroplasty	53
<b>T08.0 Fracture of spine, level unspecified closed</b>			
All	162	5-386, spinal fusion	3
		5-839.a, kyphoplasty	8
		5-839.9, vertebroplasty	3
Dementia	11	5-386, spinal fusion	-
		5-839.a, kyphoplasty	-
		5-839.9, vertebroplasty	-
<b>M48.5 non traumatic collapse of vertebra</b>			
All	1,489	5-386, spinal fusion	45
		5-839.a, kyphoplasty	295
		5-839.9, vertebroplasty	39
Dementia	71	5-386, spinal fusion	1
		5-839.a, kyphoplasty	9
		5-839.9, vertebroplasty	1

**Table 2:** ICD and OPS codes used for definition of cases with fracture of the vertebra and number of included cases.

ICD code / Definition	n	OPS code / Definition	n
<b>70.24 Atherosclerosis of native arteries of right leg with ulceration</b>			
All	37,329	5-864, Major amputation	895
		5-865, Minor amputation	1,987
With dementia	2,016	5-864, Major amputation	79
		5-865, Minor amputation	148
<b>70.25 Atherosclerosis of native arteries of left leg with ulceration</b>			
All	37,581	5-864, Major amputation	5,384
		5-865, Minor amputation	9,589
With dementia	3,308	5-864, Major amputation	638
		5-865, Minor amputation	888

**Table 3:** ICD and OPS codes used for definition of cases with advanced PAD and number of included cases.

According to the occupational regulations for the North Rhine-Westphalian physicians’ retrospective epidemiological research projects are specifically excluded from the necessity of an ethics vote. Specific linking of cases and procedures is possible but not allowed for legal reasons. Thus, institutional review board approval and patients informed consent are not necessary.

Our statistical analysis is just descriptive. Calculations were done using Microsoft® Access 2003.

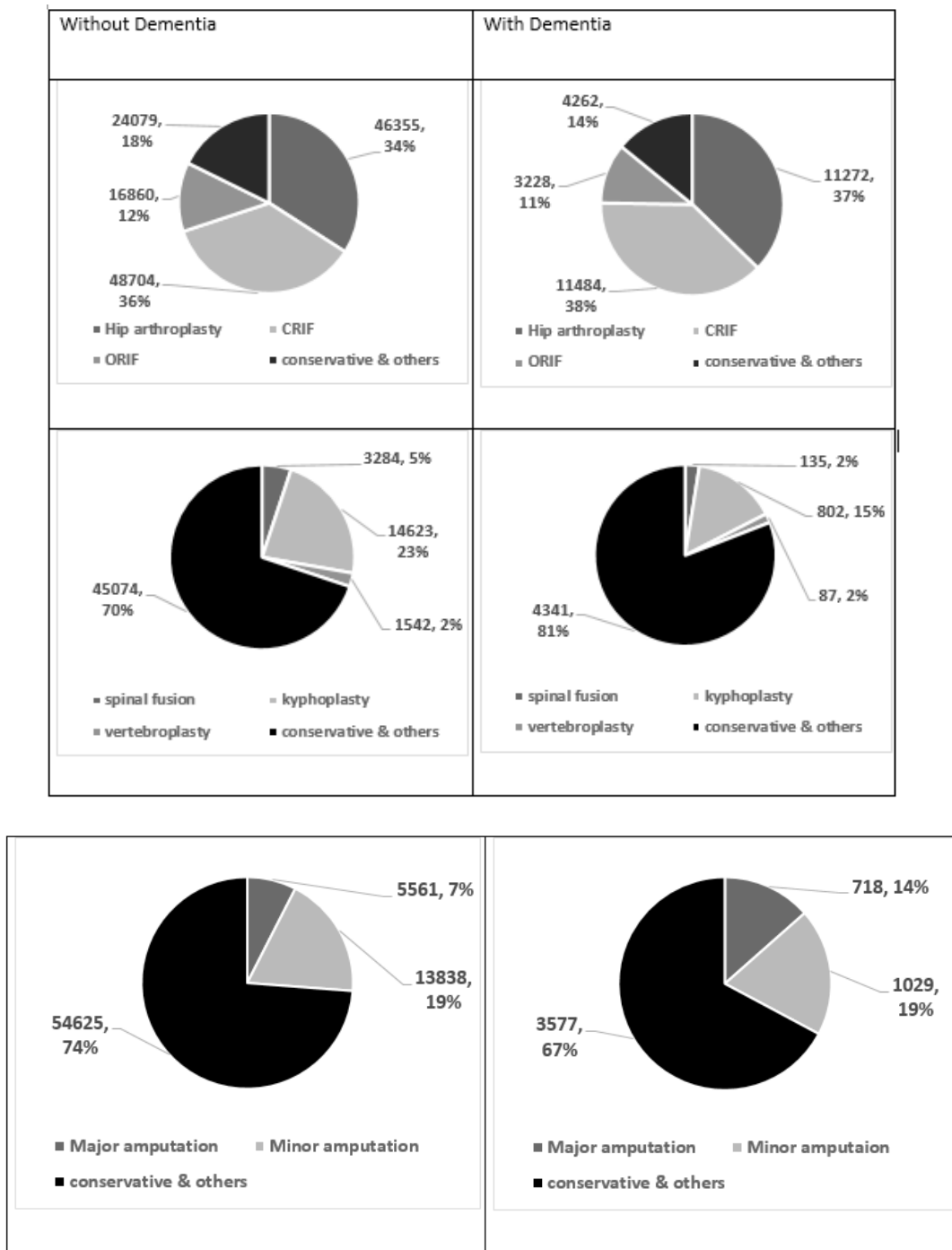
## Results

In 2019, there were 166,244 cases hospitalized with the principal diagnosis HF, 69,888 with VF and 74,910 with PAD. The rate of cases with the additional diagnosis dementia were 18.2%,

7.7% and 7.1% (Figure 1).

In cases hospitalized for HF most frequent surgical treatment was hip arthroplasty in both, cases with (37%) and cases without dementia (34%). Open Reduction and Internal Fixation (ORIF) was performed in 11% and 12% and Closed Reduction and Internal Fixation (CRIF) in 38% and 36% (Figure 1). All together, these procedures sum up to 86% in cases with and to 82% in cases without dementia.

In cases hospitalized with VF conservative treatment was the dominant treatment strategy with 70% in those without and 81% in those with dementia. Kyphoplasty (23% vs. 15%) and vertebroplasty (5% vs. 2%) were performed more frequently in patients without dementia (Figure 1).



**Figure 1:** Comparison of rates of different treatment strategies in patients with and without dementia hospitalized for HF (top), VF (middle) or advanced PAD (bottom).

In cases hospitalized with advanced PAD conservative treatment was the dominant treatment strategy with 74% in those without and 67% in those with dementia. Mayor amputation (7% vs 14%) was performed more frequently in those with dementia, but not minor amputation (19% vs 19%).

## Discussion

This analysis shows that cases hospitalized for HF, VF and PAD with the additional documented diagnosis dementia were treated differently compared to patients without dementia, in part. Conservative treatment tend to be more frequent in cases with VF and dementia. Surgical treatment with stabilization of HF by hip arthroplasty, ORIF or CRIF tend to be more frequent in cases with HF and dementia. Major amputation tend to be more frequent in cases with advanced PAD and dementia.

Patients with dementia and HF often have a poor prognosis. Despite this poor prognosis, there are limited data on which factors should take precedence in surgical decision making in these cases. A qualitative analysis of elite in-depth interviews conducted with a clinical care team involved in the management of patients with dementia after hospitalization with HF found that the three main issues discussed by most interviewees were pain control, functional status, and concomitant medical conditions. Respondents mentioned many factors related to recovery of functional status, including baseline condition, rehabilitation potential, social support, and the importance of mobility. Dementia and its impact on rehabilitation potential were mentioned by all geriatricians [28]. In patients aged 60-80 years, the decision between internal fixation and arthroplasty remains controversial. Compared with internal fixation, primary total hip arthroplasty seems to be a reasonably safe method for treating displaced femoral neck fractures in elderly patients [29]. Compared with internal fixation, arthroplasty may reduce the risk of serious complications and the frequency of reoperation and result in better pain relief and function, but does not reduce mortality [30]. The prognosis of acutely ill patients with end-stage dementia is poor. A prospective cohort study with 6-month follow-up of patients aged 70 years or older who were admitted to a large hospital with HF between September 1, 1996, and March 1998, hospitalized with HF at a large hospital in New York, NY, showed that 6-month mortality was 55% (95% CI, 42%-75%) in patients with end-stage dementia and HF, compared with 12% (95% CI, 5%-24%) in cognitively intact patients (adjusted hazard ratio, 5.8; 95% CI, 1.7-20.4). Given the limited life expectancy of patients with end-stage dementia in these conditions and the burdens associated with their treatment, increased attention should be paid to efforts to improve the comfort of this patient population [31].

Our analysis shows that dementia influences treatment decisions in HF, VF, and advanced PAD. In all three clinical situations, patient interest seems to be considered.

- In HF, stable fixation by arthroplasty, ORIF or CRIF allows better pain relief, early mobilization, and rehabilitation.
- In VF, conservative treatment avoids risk of surgical treatment with similar long-term results.
- In advanced PAD, primary major amputation is the final solution to avoid repeated revascularization procedures and gradual amputations

It appears that functional status and rehabilitation potential are weighed on one side and periprocedural risk on the other. In HF, functional status can be significantly improved by a single surgical procedure in a short time. In VF, surgical treatment can improve functional status, but results take time to achieve, and late functional outcomes after surgical and conservative therapy are not that different. In advanced PAD, multiple procedures including revascularization, wound debridement, and prolonged antibiotic treatment are required to achieve good results, and recurrence due to early stent or bypass closure is common in bedridden patients. Unfortunately, we do not have data to support these statements. We also found no study in the literature that reported in detail on individual decisions in dementia patients.

## Strengths and Limitations

A major strength of this study is the large data set, which includes virtually all German hospitals. This allows a unique view at the current clinical practice. Moreover, to the best of our knowledge, there is currently no other publication addressing this topic from a population based viewpoint in Germany.

There are factors that limit our results. First, our study design did not allow control for confounding including indications for treatment, quality of treatment, polypharmacy and relevant comorbidities. Second, the analyses are not on a per-patient basis, and patients may be included multiple times. Moreover, the DRG data do not allow for the differentiation between first-line treatments and revision procedures. Third, as we do not know how the diagnosis dementia was made, we did not enlarge on different entities. In addition, we do not have data regarding the different severity of dementia. Prospective registers with standardized classifications would be necessary to go into detail. Forth, we cannot assess if and how coding errors may have impacted our analysis. Since dementia is not specifically screened for in German hospitals, it can be supposed that it is only documented if already covered by the medical history or in the presence of obvious clinical signs. Thus, the presence of under coding can be assumed.

## Conclusion

Our nationwide analysis supports the hypothesis, that dementia impacts treatment decisions in older patients suffering from HF, VF and PAD in Germany. It seems that functional status and rehabilitation potential on the one side and periprocedural risk on the other side are weighted. The individual decisions have to be analyses to understand which specific item triggers the decision.

Ethical approval: According to the occupational regulations for the North Rhine-Westphalian physicians' retrospective epidemiological research projects are specifically excluded from the necessity of an ethics vote.

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