

Age is A Critical Factor In Wrist Function After Surgical Therapy of Patients Suffering From A-Type Distal Radius Fracture: A PROM Study

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Research Article

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Abstract

Background: Although distal radius fractures (DRF) are the most common fractures of the human body there is still no consensus concerning the best treatment option, especially for type A fractures. Moreover, studies concerning other anatomic regions could prove that patient age is of high impact on therapy and outcome. Therefore, we have quantified wrist function within a retrospective study design using PROM and we have analysed the influence of age between control and patient collective and young versus old, respectively.

Patients and Methods: The retrospective study included all patients with a surgically treated DRF type A and a control group of healthy patients, age and gender matched. The function of the wrist was examined with a self-assessment questionnaire the Munich Wrist Questionnaire (MWQ) according to the patient related outcome measurements (PROM).

Results: PROM was answered by 110 patients with DRF type A. The average follow-up was 66 months. 110 healthy wrists were the control group and subgroup matching induced similar age group distribution. Hence, 7 individuals < 30 years, 67 between 31 and 64 years, 29 control individuals between 65 and 79 years and 7 control individuals > 80 years, respectively. Women were significantly older than the men (59 ± 15 vs. 47 ± 17).

In overall analysis, there was no significant difference between control and patient group (96 ± 6 vs. 95 ± 7). Function was significantly different between control and patient group < 30 years (100 ± 1 vs. 98 ± 2). In the control group the function was significantly decreasing with advanced aging whereas in the patient group this influence was absent. The difference between age group <30 and 65-79 and >80 and between 30-64 and 65-79 and >80 was significantly different with increasing age.

Conclusion: PROM is a suitable tool for a retrospective study design as numerous patients can be analysed. The influence of age is critical for wrist function. Hence, we therefore strongly suggest that this information should be taken into consideration for future study plans.

Introduction

Distal radius fracture is a frequent injury [1–3]. Although there are several classification systems, the AO classification is the one, which is most widely distributed. While therapeutic guidelines for B- and C-type fractures are relatively clear, for A-type fractures there is an ongoing debate in scientific literature about optimal therapeutic strategy. By that, the therapeutic options vary from simple closed reduction and cast up to ORIF for dislocated A3 fractures. In this respect, many prospective randomized trials were not able to identify a significant difference between the different therapeutic branches [4] [5] [3] [6]. From the clinical point of view, the experience suggests, that dislocated or unstable A2 and 3 fractures do better after ORIF, however, so far no study could prove this clinical appearance. After thorough analysis of these studies we found that in spite of the fact that the distal radius fracture is mainly a fracture of the elderly

patient, the studies do not consider or analyze age as a very critical factor influencing the therapeutic outcome.

This appears a bit astonishing, since in other anatomical entities, such as hip fractures, it has been demonstrated clearly [7] that total hip replacement (THR) is superior to ORIF in patients above 65 years.

Hence, our aim was to clarify the question whether age might have a similar influence on wrist function after a distal radius fracture as it has been proved in femur neck fractures.

Several studies have analyzed the outcome after distal radius fracture comparing radiological results or live scores like the DASH[8] score. However, to our knowledge, so far no study exists which analyses not only objective parameters like ROM but also subjective outcome parameters after surgical treatment of a distal radius fracture. Therefore to identify patients' needs we did not use radiological data but a specifically developed questionnaire (PROM) for wrist function, which has been validated and published before [9]. To answer the question of the influence of age we first identified patients in the register and then matched in a pairwise manner age and sex matched couples to gain correct comparison.

Therefore, the aims of this study were

- i) Quantify wrist function within a retrospective study design using a PROM on patients enlisted in our fracture register suffering from AO type A-fracture/surgical therapy ORIF
- ii) Compare the obtained data to age and sex matched pair controls in respect of relevant age groups

Patients And Methods

This retrospective cohort study was approved by the local ethics committee (409/15s) and all control individuals as well as patients gave their written informed consent prior to participation.

Study Group

For this retrospective setting, we identified patients out of our fracture register suffering from distal radius fractures classified as A-type fractures according to the AO classification system and were treated surgically within an observation period from 2006 until 2016.

Exclusion criteria were external fixation, primary surgery elsewhere, history of previous trauma or multiple injuries.

Control Collective

For control, healthy individuals were recruited and demographic data such as age and gender were adjusted to the study collective in order to obtain an objective control collective as good as possible in

terms of matched pairs. Exclusion criteria were history of previous injuries of the upper extremities, relevant diseases with potential negative influence of wrist function, such as rheumatoid arthritis etc.

Surgical Therapy

All patients were operated by the following procedure: standardized modified approach described by Henry, volar plating using either a monoaxial or polyaxial locking plate (i.e. Depuy Synthes, Medartis etc.). All patients received a standardized after care physiotherapy program and were seen in our out patient center for regular checkups.

Evaluation Of Wrist Function

For functional measurement of wrist function, all control individuals as well as all patients filled in the standardized Munich Wrist Questionnaire (MWQ). This questionnaire was designed as a scientific instrument to analyze wrist function as a Patient Reporting Outcome Measurement (PROM). This instrument allows for quantitative measurement of wrist function and gives a result as a percentage of a potential 100% function and has been validated previously[9].

Analysis

Epidemiological and demographic data were summarized and given in mean±standard deviation (MW±SD) for age and postoperative observation period. Frequencies of gender etc. were given in (%). For subgroup analysis, the functional results were summarized calculating mean values and standard error of the mean (MW±SEM).

For quantitative analysis, wrist function parameters of control and study group were compared using Mann-Whitney-U-test. To analyze the influence of age, control and study collective were divided into 4 subgroups: <30, 30-64, 65-79 and >80 years. Then, the functions of these subgroups were analyzed calculating Kruskal Wallis One way Analysis of variances (ANOVA) and after identifying significant differences, as a post-hoc test Dunn´s method for pairwise comparison was used to identify significantly different group. By that, a p-value<0.05 was accepted as significant.

Results

Epidemiological and demographic data

Study group

In this study, 110 patients suffering from A-type fractures of their distal radius were enrolled. All of them were treated using the Open Reduction and internal fixation (ORIF) strategy using volar plating with

locking plates. The epidemiological and demographic data is given in Table 1. The mean follow up time was 66±29 months

Subgroup analysis revealed 7 patients <30 years, 67 patients between 31 and 64 years, 29 patients between 65 and 79 years and 7 patients >80 years, respectively.

Control group

From these patients, we identified control individuals of similar age and sex and without relevant pathology in the wrist, such as trauma, rheumatoid arthritis etc.. The epidemiological and demographic data is given in Table 1. In the control group, due to matched paired study design, also 110 individuals were enrolled and subgroup matching induced similar age group distribution. Hence, 7 control individuals < 30 years, 67 control individuals between 31 and 64 years, 29 control individuals between 65 and 79 years and 7 control individuals > 80 years, respectively (Table 1).

Table 1
Epidemiological and demographic data of control and study group.

	Age (MW±SD)	Female n (%)	Male n (%)	Dominant hand in (%)	Non-dominant hand in (%)
Control	55±19	71 (65%)	39 (35%)	55 (50%)	55 (50%)
Fracture	56±16	88 (80%)	22 (20%)	47 (43%)	63 (57%)

Functional Results In Mwq

Control individuals as well as patients filled in MWQ and the results were computed to a relative quantitative functional value given in (%) from the standardized 100% function of the questionnaire. The results are given in Table 2.

Table 2
MWQ Results

MWQ in (%) MW±SD	All	<30 n= 7	30-64 n= 67	65-79 n= 29	>80 n= 7
Control	96±6	100±1	97±4 *	93±7 #	89±7
Fracture	95±7 †	98±2	95±7	93±8	95±9

This table depicts the quantitative functional results of the wrist joint according to a standardized Patient Related Outcome Measurement (PROM) instrument. In overall analysis, no significant difference was calculated (Mann-Whitney-U test, p-value <0.05). In subgroup analysis, only between the <30 years group and the control a significant difference was present in U-test (p<0.05 †) whereas in Kruskal-Wallis ANOVA

on ranks significant differences were calculated between age groups of the control group. The post-hoc analysis calculated by Dunn's pairwise comparison revealed differences between the <30 years group and the 65-79 and >80 group (*) as well as for the 30-64 group in comparison to the 65-79 and >80 years group (#). This supports that the influence of age is more critical to wrist function than fracture followed by surgical therapy.

In overall analysis, there was no significant difference between control and patient group (96 ± 6 vs. 95 ± 7) (Fig. 1).

In subgroup analysis of age groups, function was significantly different between control and patient group under the age of 30 (100 ± 1 vs. 98 ± 2). Interestingly, in the control group the function was significantly decreasing with advanced aging whereas in the patient group this influence was absent (Fig. 2).

In ANOVA on ranks the difference between age group <30 and 65-79 and >80 as well as between 30-64 and 65-79 and >80 was significantly different with increasing age.

Discussion

In this study we could demonstrate, that the influence of age is critical for wrist function. In case of patients suffering from A-type fractures treated by modern surgical therapy, the influence of the severity of the injury and surgical therapy is considered minor compared to age. Hence, the important information towards the scientific society from these data is, that the incongruent study results of post-injury function after distal radius fracture might be severely influenced by study designs, which do not respect this critical influence of age. By the strong support of these data, we therefore strongly suggest that this information should be taken into consideration for future study plans [10, 11]. This might be a similar effect as compared to studies following proximal femur fractures.

We analyzed patients from our fracture register within a retrospective cohort design, since we intended to enroll as many patients as possible overseeing the longest possible observation period. This is in line with previous published studies also using retrospective designs [12, 13].

In contrast, other authors propose that prospective randomized trials provide less biased results due to elimination of confounders [14, 15]. However, in recent discussions especially about surgical therapies, it was clearly identified, that prospective studies are also affected by potential BIAS due to surgeons preferred techniques [16]. Nobody will deny that surgeons are influenced by a certain preferred technique and it is absolutely clear that they will perform in their preferred technique better compared to another technique, they were taught just for scientific reasons. Hence, surgical studies with randomized therapeutic branches suffer from a selection BIAS of patients and surgeons. Therefore, prospective randomized trials in surgical therapy are more and more considered to not reflecting the "real" world and scientific answers of complex question might be better answered by big data analysis of big registry data. However, it is clear that this discussion is still ongoing.

There are 3 main follow-up concepts: Calling the patients at home, inviting them to the hospital to clinically survey them and PROMs (Patient Rated Outcome Measures). As the patient satisfaction is a relevant parameter of successful treatment questionnaires display this parameter in their score. They can be used to contact many patients at a time, not leading to any costs for the patients.

Although there are many PROMs like the DASH [17] or the PRWE [18] we decided to use the Munich Wrist Questionnaire by Beirer et. al [9], which is focussed on the wrist and includes not only objective, but also subjective parameters. In contrast to other PROMs like the DASH Score, the MWQ is not only specific for the wrist, but it provides also informations about the objective outcome like the wrist ROM, etc..

We found that age has a significant influence on wrist function in control individuals. Hence, we strongly recommend for further studies on distal radius fractures to divide patient collective at least in a group below and a group above 65 years, similar to studies on proximal femur fractures. This was supported by other authors [19]. Quadlbauer et al. could show that patients younger than 64 years and older than 65 years had the same good outcome after volar locking plate osteosynthesis for DRF [19]. This comes along with the studies publicated by Tulipan et al. and others who could show the elderly also had a good outcome. They stated that osteosynthesis should be offered to the elderly [11] [20].

Women, especially elderly women were significantly more often suffering from DRF type A. This comes along with findings from other publications [2, 21]. The rate of osteoporosis in this age group is high. Niempong et al. could show that 59.5% of the patients enrolled in his study aged older than fifty years with the majority being 60-69 years old were osteoporotic [2]. When it comes to osteoporosis, surgical treatment is more complex and complication rates are higher due to the poor bone quality. Moreover, this study showed that patients suffering from A2 fractures were significantly younger than patients suffering from the more complex A3 fracture, which might be due to the poor bone quality [21] [22].

In the control group, the function was significantly decreasing with advanced aging whereas in the patient group this influence was absent. Even the patients older than 80 years had a function similar to the younger patients. This is of great interest regarding the question whether the DRF type A should be treated surgically.

As only surgically treated patients were enrolled in this study, the control group consists of healthy individuals. For analyzing the question about conservative or surgical treatment, a control group of conservatively treated individuals would be of high interest.

Conclusion

The influence of age is not only critical for wrist function but the influence of injury and surgical therapy is considered minor compared to age. This should be taken into consideration when interpreting study results or designing a study. The presented study design, a fracture register within a retrospective cohort design has several advantages over a randomized controlled trial, in particular the elimination of the

selection BIAS of patients and surgeons. Moreover, PROM is a suitable tool for fast and easy data collection.

List Of Abbreviations

PROM Patient related outcome measurement

MWQ Munich Wrist Questionnaire

DRF Distal Radius Fracture

Declarations

Ethics approval and consent to participate

This retrospective cohort study was approved by the local ethics committee (409/15s) and all control individuals as well as patients gave their written informed consent prior to participation.

Consent for publication

NA

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors have no competing interests

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Authors' contributions

FvM has substantially contributed to the design of the work and has contributed to interpretation of data

JW has substantially contributed to the acquisition and analysis

MM has substantially contributed to the acquisition and analysis

PB has substantially contributed to the conception and has revised the work

HA has substantially contributed to the conception, has drafted and revised the work and has contributed to interpretation of data

All authors read and approved the final manuscript.

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Figures

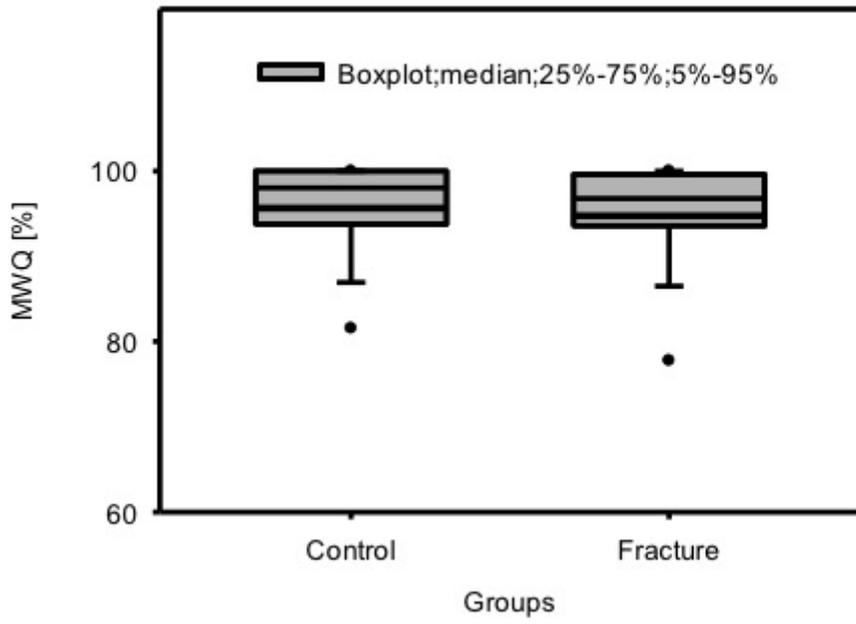


Figure 1

This graph depicts boxplots of overall functional wrist results of control individuals as compared to patients suffered from A-type fractures. There is no significant difference. Boxplots are characterized by Median (bold line), 25%-75% Percentile, 5%-95% Percentile.

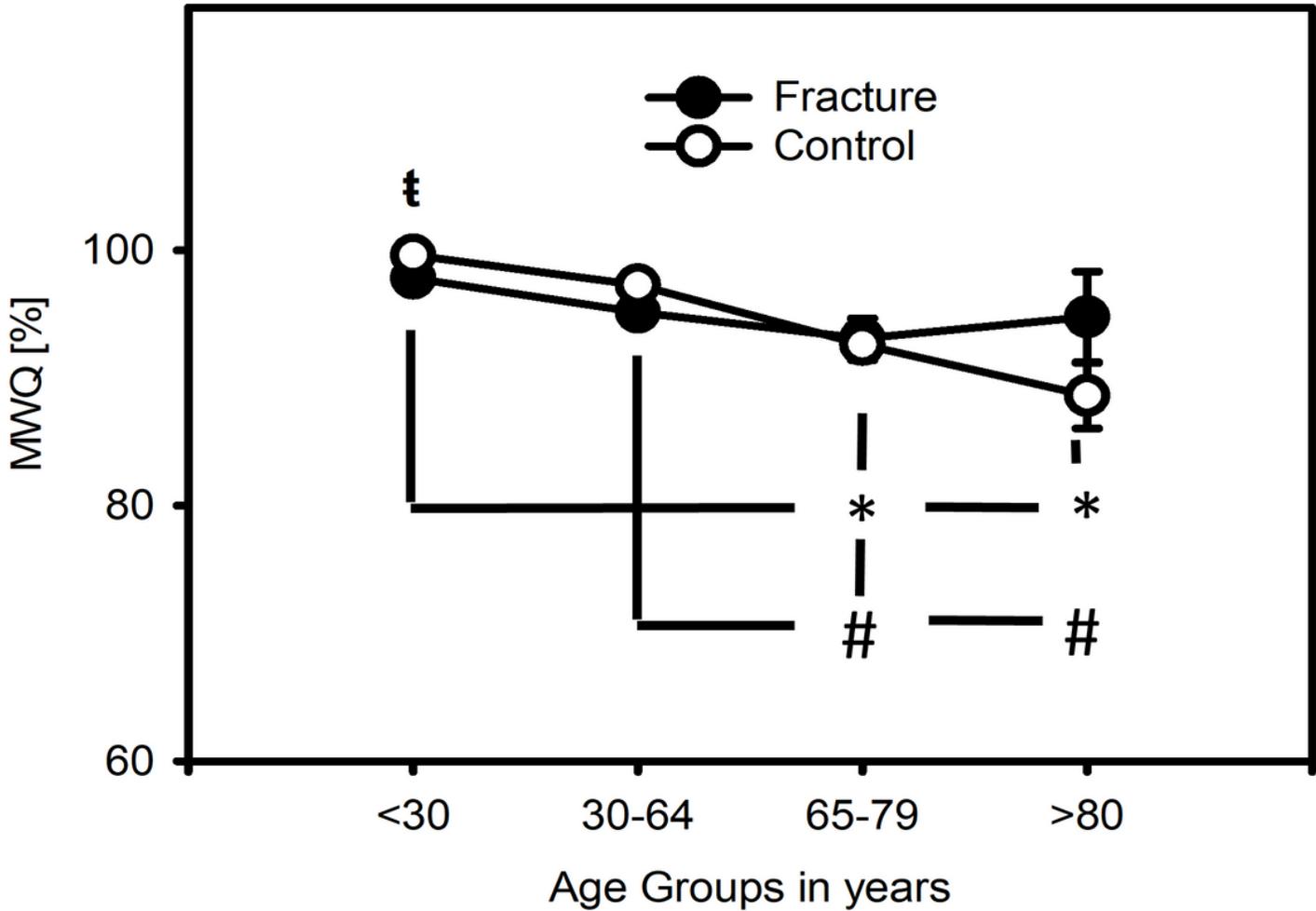


Figure 2

This graph depicts the subgroup analysis on controls and patients divided in age groups <30, 30-64, 65-79 and above 80 years. Between control and fracture, only in the group <30 years a significant difference was calculated between control and fracture (†). In ANOVA on ranks the difference between age group <30 and 65-79 and >80 as well as between 30-64 and 65-79 and >80 was significantly different with increasing age (*, #)

† p<0.05 in Mann Whitney U test control vs. fracture <30 years;

*, # p<0.05 in Kruskal Wallis Analysis of Variances on ranks followed by Dunn’s pairwise testing

Values are given in MW±SEM.