

Increase of weight-bearing capability of patients with lesions of the TFCC using a wrist brace

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Abstract

Purpose

In this retrospective analysis, we tested if the weight-bearing capability of patients with TFCC lesions can be increased by wearing a brace that stabilises the distal radioulnar joint.

Methods

Twenty-three patients had an arthroscopically confirmed TFCC lesion. We compared preoperative dynamic weight-bearing test of both hands with and without a commercially available wrist brace (WristWidget ®). Subgroup analysis was performed for degenerative and traumatic TFCC lesions and intraoperative stability of the distal radioulnar joint was tested. We used parametric tests for normally distributed values.

Results

The weight-bearing capability of the injured hand was significantly lower than of the contralateral hand. With brace, the injured hand showed a significant increase, but not to contralateral values. The device had no effect on the healthy hand. Sixteen patients with traumatic lesions had a significantly lower weight-bearing capability compared to seven with degenerative lesions. The absolute increase using the brace

was not different, in contrast to the relative gain. Comparison of eleven cases with stable and twelve cases with unstable distal radioulnar joint showed no difference.

Conclusion

Stabilisation of the distal radioulnar joint increased the maximum tolerated axial load of wrists with a lesion of the TFCC.

Trial registration

DRKS: DRKS00020350

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Keywords: TFCC, traumatic, degenerative, wrist, brace, WristWidget

A. Asmus and M. Salloum contributed equally to this work.

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Conflicts of interest/Competing interests

Wendy Medeiros: Inventor and distributor of the WristWidget

Ethics approval

The ethics committee of the University Medicine of Greifswald approved the retrospective data collection and analysis (BB103/19).

Consent to participate and for publication

Written consent for retrospective data collection, analysis and publication was obtained from each patient.

Availability of data and material

Anonymised data can be made available upon request.

Introduction

The triangular fibrocartilage complex (TFCC) is a contributor to the stability of the distal radioulnar joint (DRUJ) and axial stability of the forearm [1-3]. Lesions of the TFCC may manifest with ulnar sided wrist pain on axial load and DRUJ instability [4]. Clinical tests include pressure in the fovea ulnaris, forced ulnar deviation, and assessment of DRUJ stability among others [5]. As diagnostic imaging might show a false negative result, the arthroscopic examination is the standard for diagnosing and treating lesions [5]. According to the site and shape of the lesion, the Palmer classification differentiates between traumatic and degenerative lesions [6]. In patients with stable DRUJ, a conservative treatment with splinting and pain medication showed comparable results to the arthroscopic treatment [7]. But from our experience, pain on axial load is insufficiently addressed by splinting as well as the wrist movement is restricted. The positive effect of carpal-stabilising taping for the treatment of dorsal wrist pain has been proven [8]. One of the authors (WM) of this study invented a wrist brace for patients who refused surgery that consists of two parallel tapes, one distal and one proximal of the ulnar head, and observed a high patient satisfaction and increased axial load capability in the weight bearing test.

In this study we retrospectively analysed the weight bearing test of patients who had a confirmed TFCC-lesion in arthroscopy.

Materials and Methods

Our database listed 23 patients who were admitted between 01/2019 and 12/2019 to our hospital for wrist arthroscopy with suspected TFCC lesion, who performed the weight bearing test with and without a wrist brace and had an arthroscopically

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confirmed TFCC-lesion. The wrist brace was a standardised commercially available brace (WristWidget®, Hawaii, USA). We analysed onset and suspected aetiology of symptoms, hand dominance, side of complaint, and the DASH-score. Data of physical examination included the range of motion of the wrist, grip strength of both hands, tenderness of the TFCC (Fovea sign) and painful ulnar deviation of the affected hand. For the weight bearing test, patients were asked to place the wrist in the middle of the scale with extended arms. The maximum weight that could be reached with and without brace was documented for both hands. Ulnar variance and ulnar shift were measured for both hands on preoperative X-rays during a modified weight bear test. For this purpose, the patient closed his fist around a wooden bar while putting axial load on the examination table. For cases including an MRI, the TFCC-lesion was classified as suspicious for traumatic or degenerative origin. The type of TFCC lesion and assessment of DRUJ-stability were obtained from surgery records

The institutional review board reviewed and approved the retrospective study (BB 103/19). We obtained informed consent from all patients for the use and publication of their data.

Values are rounded to the first decimal or integers depending on the variable. Determination of variable distribution was performed visually, by Kolmogorow-Smirnov-test and by Q-Q Plot. Normally distributed values are presented with mean and standard deviation, the other with median and interquartile range. For normal distributed values, the paired and unpaired t-test was used. Categorical variables were tested using Fisher's exact for expected counts less than five. A p-value of ≤ 0.05 was considered significant and adjusted in case of multiple comparisons.

Results

The included patients had a mean age of 45 (standard deviation 13) years at time of symptom onset and presented at a median of 214 days (interquartile range 235) after onset, mean preoperative DASH was 47 (standard deviation 17).

All patients were right hand dominant; the lesion was located on the right side in 15 cases. Sixteen patients remembered a trauma, 14 described a painful pronation, and 19 a painful supination. Ulnar deviation of the affected hand was painful in 18 cases. The fovea sign was positive in 13 patients. Five patients had a positive, nine patients a neutral, and nine patients a negative ulnar variance. Ulnar variance was not associated with traumatic or degenerative lesions in our sample (n=23, p=0.193, Fisher's exact).

Values of the clinical examination are shown in table 1.

Clinical test	Affected hand	Healthy hand	p	n
Handgrip strength [kg]	22 (12)	34 (11)	< 0.001	22
ROM [degree]	153 (32)	190 (22)	< 0.001	22
PS [degrees] *	163 (21)	170 (0)	0.005	22
Ulnar shift [mm]	0.42 (0.7)	1.19 (0.9)	0.003	18
Weight bear	16 (9)	36 (12)	<	23

test [kg]			0.001	
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Table 1 ROM: sum of extension/flexion/ulnar_duction/radial_duction in degrees, paired t-test. PS: sum of pronation/supination in degrees; values are not normally distributed and presented with median and interquartile range. Statistic test was performed using Mann-Whitney-U.

Effect of the wrist brace on the weight bearing test are shown in figure 1. The healthy side showed no significant difference for values obtained with and without brace (36 [13] vs 35 [12] kg, n=22, p=0.325, paired t-test). The weight bear capability during x-ray was significantly lower for the healthy hand (23 [8] kg, p<0.001, paired t-test) and affected hand (14 [8] kg), p=0.036, paired t-test).

Twenty-two patients had a preoperative MRI with 1 or 1.5 T which showed a suspected traumatic lesion in 16 cases. The agreement between MRI and intraoperative result for the differentiation of traumatic and degenerative lesions was moderate with a kappa of 0.556.

In X-ray, ulnar shift was significantly lower on the affected side with 0.25 (0.8) mm compared to the contralateral side with 1.3 (1.8) mm (n= 18, p = 0.009, Wilcoxon-test). The maximum weight bearing tolerance during x-ray was significantly lower on the affected hand with 13 (8) kg compared to the contralateral hand with 23 (11) kg (n=18, p< 0.001, paired t-test).

Comparison between patients with degenerative and traumatic lesions determined by arthroscopy is shown in table 2.

Test	Traumati	Degenerativ	p	n
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Age at onset [years]	42 (12)	55 (9)	0.016	23
Time between onset and presentation [days] *	173 (185)	382 (764)	0.006	23
DASH	44 (18)	56 (10)	0.232	16
Handgrip strength on affected side [kg]	19 (12)	29 (9)	0.050	22
Handgrip strength on healthy side [kg]	33 (11)	37 (10)	0.371	22
Weight bear on affected side [kg]	13 (7)	23 (8)	0.008	23
Weight bear with brace [kg]	17 (8)	27 (9)	0.016	23
Absolute gain caused by the brace [kg]	4.0 (2.6)	3.7 (2.0)	0.823	23
Weight bear test during X-ray [kg]	11 (6)	17 (11)	0.141	18
Ulnar shift [mm]	0.28 (0.7)	0.64 (0.7)	0.309	18

Table 2. Comparison between traumatic and degenerative TFCC-lesion. *Values for 'Time between onset and presentation' are not normally distributed and given with

median and interquartile range. Statistic test was performed using Mann-Whitney-U. All other values are mean with standard deviation and statistic test using the unpaired

t-test.

Discussion

Our study showed that the wrist brace could increase the maximum tolerated axial load of wrists with TFCC lesions. The brace had no effect on the healthy hand. There was no difference in the weight bearing test between patients with stable and unstable DRUJ. This might be due to the small sample size or subjective clinical examination result.

After the 'Press test' which used the body weight on arm rests [9], the 'Push Off' test was developed where the patient would lean on a grip dynamometer to obtain quantitative results for follow up examinations [10]. We used an analogue scale as it is less expensive and can show the maximum possible load (dynamic test). We did not test the sustained load (static test) due to time constraints in the preoperative setting. X-ray during weight bear testing is possible but shows lower values for both hands. A similar study using a defined load of 18.1 kgf described a correlation of a 1 mm increase of ulnar variance with an intraarticular pathology [11]. This result could not be reproduced in group because an axial load of 18 kg could not be reached by the participants during X-ray.

Patients with a degenerative lesion of the TFCC present later than those with a traumatic lesion and are stronger in all strength tests of the affected hand. Patients with a traumatic lesion might suffer from stronger exertional pain which might also be reflected in the smaller ulnar shift compared to the healthy hand during X-ray.

Even though patients with a traumatic lesion had a significantly lower weight bear capability than those with a degenerative lesion, absolute gain was identical. As the relative gain is higher, patients with a traumatic lesion might feel more gain in strength.

A study on ulnocarpal impaction found no difference in ulnar variance between the symptomatic and contralateral wrist [12]. Ulnar variance had no influence on clinical results in our sample but the sample size is too small for interpretation.

We compared only traumatic and degenerative lesions. A more detailed subgrouping according to the lesion site (Palmer) or using the Atzei-classification would need a larger sample. The agreement between the MRI report and surgeon regarding the aetiology was only moderate which might be attributed to the magnetic field strength of 1-1.5 T or the subjective factor of the surgeon which was shown in a review of diagnostic accuracy [13, 14].

To answer the remaining questions, we have started a prospective study registered under the same trial number DRKS00020350, available at www.drks.de.

Figures

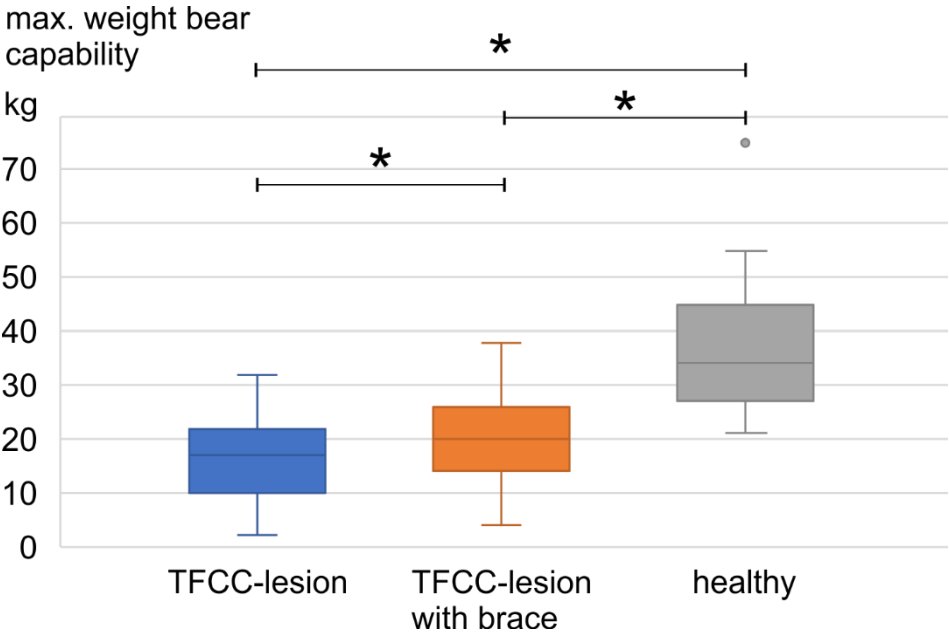


Fig. 1 Weight bear test results. The weight bear test showed a significantly lower weight bearing capability of the side with TFCC lesion compared to the healthy hand (n=23, p< 0.001, paired t-test). Using the brace, the affected side reached a significantly higher maximum load (n=23, p< 0.001, paired t-test). The affected side with brace could not reach the load of the healthy side (n=23, p< 0.001, paired t-test). Using the Bonferroni correction for multiple comparisons, the adjusted significance level was 0.016.

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