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Outcome of Surgical and Conservative Treatment of Patients with Shoulder Impingement Syndrome – a Prospective Comparative Clinical Study

Výsledky chirurgické a konzervativní léčby pacientů s ramenním impingement syndromem – prospektivní srovnávací klinická studie

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ABSTRACT

PURPOSE OF THE STUDY
Subacromial impingement is one of the most common reasons for shoulder pain. The surgical management of this condition has recently become the focus of criticism because of the rising number of surgical procedures and the lack of superiority of surgical over conservative treatment. In this prospective comparative study, we compared standardised conservative care with surgical treatment and placed special emphasis on the patients' ability to work.

MATERIAL AND METHODS
A total of 106 patients (25 women, 81 men; mean age: 45.4 ± 12.3 years) were included in this prospective comparative clinical study. Patients in the non-operative arm (n = 42) received standardised physiotherapy. Patients in the surgical arm (n = 38) underwent arthroscopic subacromial decompression. All patients were followed up at 3, 6 and 12 months. Shoulder function (Constant score), pain (Numerical Rating Scale), and the duration of inability to work were assessed.

RESULTS
Shoulder function and pain improved significantly with both kinds of treatment. At no time of follow up we detected significant differences between the two treatment options. An analysis of the patients' ability to work showed that conservative treatment was superior to surgical treatment at 3-month follow-up (0.3 versus 5.0 weeks; $p < 0.001$) and between 4 and 6-month after intervention (0.2 versus 1.6 weeks; $p = 0.032$).

DISCUSSION
In the study presented here, significant improvements in function (Constant score) and pain (NRS) were achieved in both the non-operative and the surgical arm. There were no significant differences between the two groups at any time point. These results are similar to those reported by other authors in recent studies. Unlike other research work, however, our study demonstrated a major difference in the development and duration of inability to work.

CONCLUSIONS
Conservative and surgical treatment of subacromial impingement syndrome led to similar outcomes for shoulder pain and function at 3, 6 and 12 months after intervention. However, patients who were managed conservatively returned to work significantly earlier than patients who underwent surgery.

Key words: subacromial impingement, shoulder, constant score, pain, ability to work.

INTRODUCTION

Different types of shoulder impingement syndrome are distinguished today (8), i.e. primary and secondary extrinsic (outlet) impingement, intrinsic (non-outlet) impingement, and internal impingement (2). Primary extrinsic impingement includes subacromial and subcorarcoidal impingement. Secondary extrinsic impingement is caused by hyperlaxity or instability of the glenohumeral joint. Intrinsic impingement results from rotator cuff changes. Posterior-superior and anterior-superior internal impingement is most commonly seen in overhead athletes and swimmers (2).

If there is no structural damage (e.g. rotator cuff injuries, damage to the tendon of the long head of the biceps, symptomatic osteoarthritis of the acromioclavicular joint), impingement syndrome should initially be managed conservatively (11). In these cases, physiotherapy is the mainstay of treatment and focuses on strengthening the rotator cuff and the fixing muscles of the scapula and further on reducing pain, for example with non-steroidal anti-inflammatory drugs (NSAIDs) and corticosteroids (5, 19, 22). If symptoms fail to improve with conservative treatment, surgery may be considered (4, 7, 21). The

most common surgical intervention is arthroscopic subacromial decompression (ASD), which involves the removal of affected bursa tissue, the resection of subacromial bone spurs, and tendon debridement (1, 13). Although good results have been reported for conservative treatment, ASD has increasingly been performed in recent years (20, 25). This is widely debated and sometimes questionable, since recent studies did not provide a relevant benefit of arthroscopic surgery over conservative treatment or a placebo procedure (1, 18).

There are only a few studies that investigate the return to work after treatment. In a retrospective study that was conducted in 2011, patients were able to return to work at a mean of 11.1 weeks after ASD (15). The duration of inability to work and treatment costs play a major role in an evaluation of cost-effectiveness. In a Finnish study from 2009, the mean costs of ASD were calculated to amount to EUR 2,961. These costs included the surgical procedure, physiotherapy, travel expenses, hospital stay, medications, and visits to health care providers. Costs resulting from absence from work were not considered (12). The costs of conservative treatment alone were not reported.

In our prospective clinical study, we compared the outcomes of patients with primary extrinsic impingement syndrome who underwent ASD to those of patients who were managed with physiotherapy as ordered by a physician. The objective of this study was to assess shoulder function, pain and inability to work at different times and to evaluate the effectiveness as well as the advantages and disadvantages of both treatment options.

MATERIAL AND METHODS

Patients

A total of 106 patients who were treated for primary extrinsic (outlet) shoulder impingement between July 2013 and June 2017 were included in this prospective comparative clinical study. Before the patients were referred to us and were included in the study, they had received non-standardised conservative care of varying amount by different referring physicians with no sufficient improvement of symptoms for at least six weeks. To be included patients had to have clinical signs of impingement syndrome, diagnostic magnetic resonance imaging (MRI) scans demonstrating the absence of structural damage like lesions of the rotator cuff, patients' consent to undergo standardised conservative or surgical treatment, patient age ≥ 18 years and ≤ 70 years, and written informed consent. Patients suffering from rheumatic diseases, osteoarthritis of the shoulder, shoulder instability, pathologies of the tendon of the long head of the biceps, injuries to the glenoid, and disruption of the rotator cuff tendon were excluded. In two cases, the surgical procedure detected a relevant lesion of the rotator cuff which had not been identified on MRI scans. One patient was found to have rheumatoid arthritis. Twenty-three patients withdrew from the study for personal reasons. As a result, we were able to completely analyse 80 of the initial 106 data sets. Figure 1 provides an overview of the group sizes at relevant time points. Patient characteristics are given in Table 1. All patients were fully informed about both treatment options. Regardless of the severity of complaints, every patient was assessed as to whether it was possible for him or her to receive conservative treatment in accordance with the study protocol. Patients who did not meet this requirement and patients who explicitly wished to have surgical treatment and met all inclusion/exclusion criteria were assigned to the surgical treatment arm. All patients were followed up at 3, 6 and 12 months.

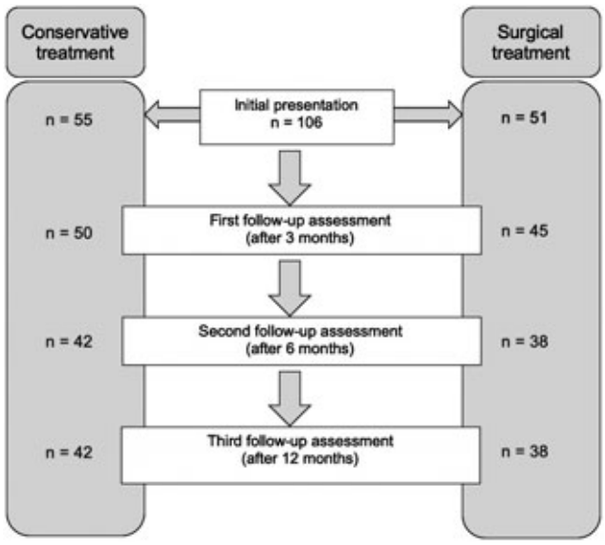


Fig. 1. Numbers of patients per treatment arm at relevant time points.

Table 1. Patient characteristics. Physiotherapy group, surgical treatment group and all patients. Values are means and standard deviations or proportions

Variable	Physiotherapy n = 55	Surgical treatment n = 51	Total n = 106
Age (in years)	40.8 (±10.7)	50.3 (±12.1)	45.4 (±12.3)
Number of females	9 (16.36%)	16 (31.37%)	25 (23.58%)
Body mass index	27.6 (±4.1)	27.6 (±5.9)	27.6 (±5.0)
Height (in m)	1.79 (±0.07)	1.77 (±0.099)	1.79 (±0.08)
Weight (in kg)	88.85 (±13.99)	86.18 (±17.08)	87.6 (±15.5)
Waist circumference (in cm)	97.6 (±10.6)	98.7 (±11.77)	98.1 (11.2)

Apart from biometric data (e.g. height, weight, age, and sex), we assessed the following patient parameters: shoulder function (Constant score), pain using the Numerical Rating Scale (NRS), and the duration of inability to work. The duration of inability to work before study inclusion and at 0 to 3 months, 4 to 6 months and 7 to 12 months after study inclusion were analysed separately.

The study was approved by the responsible ethics commission (Ref.: A-2013-0135).

Conservative treatment

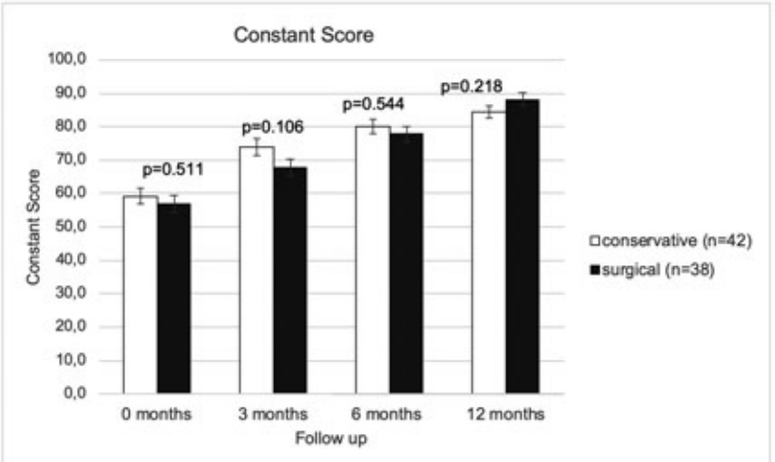
The focus of standardised conservative treatment was on re-establishing coordination of the scapula fixing muscles in a structured manner. For this purpose, the following therapies were provided by a physician or a physiotherapist in every patient: exercises (shoulder stabilisation, lifting against gravity, exercises that extend the spine but do not involve lifting the arm against gravity), exercise therapy using equipment (strengthening of shoulder muscles), manual therapy (mobilisation of the scapula, cervical spine and thoracic spine, relaxation and trigger point techniques, friction massage, caudal gliding, traction), and additional therapies (ultrasound, Kinesio taping, electrotherapy). We subscribed an amount of three treatments per week during the first two weeks, followed by two treatments per week for approximately four weeks and, where appropriate, further episodic care until the patient was free of symptoms. The treating physician assessed whether the patient performed the exercises correctly. Eleven patients with subacromial bursitis received subacromial injections with bupivacaine and dexamethasone (a maximum of three injections at minimum intervals of two weeks). Four patients with acromioclavicular joint osteoarthritis received injections into the joint in addition to physiotherapy (again a maximum of three injections at minimum intervals of two weeks). Physiotherapists were instructed to write reports. These reports and patient interviews at follow-up visits allowed us to assess whether the prescribed exercises were performed correctly. A subgroup analysis was performed in order to evaluate the quality of physiotherapy on the basis of adherence to the interventions ordered by a physician.

Surgical treatment

Patients received written information about the planned surgical procedure before surgery and they were provided with surgical treatment according to their specific needs. All surgical patients underwent diagnostic shoulder arthroscopy, followed by arthroscopy of the subacromial space. After electrothermal removal of bursa tissue, bone spurs were resected. When subacromial narrowing caused by acromioclavicular joint osteoarthritis and osteophytes were present with typical symptoms, patients also underwent arthroscopic resection of the acromioclavicular joint (n = 3). After surgery, standardised physiotherapy with focus on mobilisation was recommended.

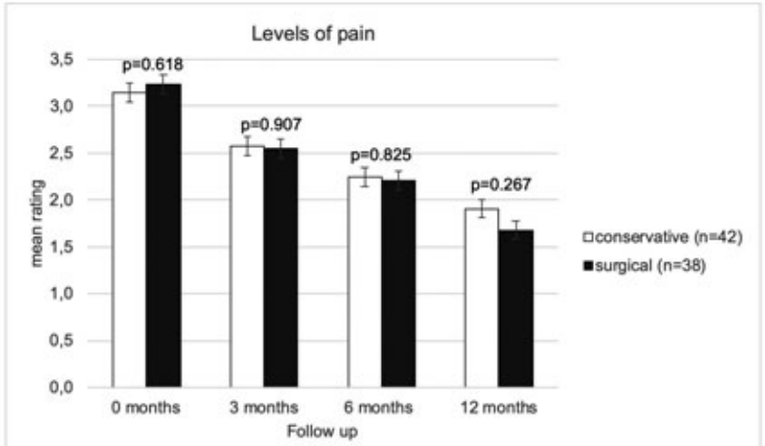
Statistical analysis

Data were summarised using descriptive measures. Continuous variables were expressed as means ± one standard deviation (SD). Categorical data were expressed as absolute and relative frequencies. Normality was tested using the Shapiro-Wilk test and graphically using quantile-quantile (Q-Q) plots. Differences between patients undergoing either surgical or conservative treatment in terms of the duration of inability to work, pain levels (NRS) and shoulder function were assessed using mixed analysis of variance (ANOVA) for calculating effects of group and time. In addition, effects of age, sex and BMI were included as covariates. Post-hoc multiple comparisons were performed using Tukey's test. Effects of treatment adherence in patients receiving conservative treatment were assessed in a subgroup analysis. All models are based on available data. The level of significance was set at $\alpha = 5\%$ ($p \leq 0.05$). Statistical analyses were performed using IBM SPSS Statistics software package 23.0 (SPSS, Chicago, IL).



Conservative treatment	At the beginning of treatment	At 3 months	At 6 months	At 12 months
At the beginning of treatment	x	< 0.001	< 0.001	< 0.001
At 3 months	x	x	< 0.001	< 0.001
At 6 months	x	x	x	0.004
At 12 months	x	x	x	x
Surgical treatment				
At the beginning of treatment	x	< 0.001	< 0.001	< 0.001
At 3 months	x	x	< 0.001	< 0.001
At 6 months	x	x	x	< 0.001
At 12 months	x	x	x	x

Fig. 2. Assessment of shoulder function using the Constant score at 0, 3, 6 and 12 months after the beginning of conservative or surgical treatment and effects (p-value) within treatment groups (below the column bar chart), adjusted for age, body mass index (BMI) and sex.



Conservative treatment	At the beginning of treatment	At 3 months	At 6 months	At 12 months
At the beginning of treatment	x	< 0.001	< 0.001	< 0.001
At 3 months	x	x	0.024	< 0.001
At 6 months	x	x	x	0.016
At 12 months	x	x	x	x
Surgical treatment				
At the beginning of treatment	x	< 0.001	< 0.001	< 0.001
At 3 months	x	x	0.023	< 0.001
At 6 months	x	x	x	< 0.001
At 12 months	x	x	x	x

Fig. 3. Assessment of pain using the Numerical Rating Scale (NRS) at 0, 3, 6 and 12 months after the beginning of conservative or surgical treatment and effets (p-value) within treatment groups (below the column bar chart), adjusted for age, body mass index (BMI) and sex.

RESULTS

Constant score

Both conservative and surgical treatment led to significant improvements in Constant score at all times of follow-up. There was no significant difference between the two treatment approaches at any time (Fig. 2).

An analysis of the effect of the quality of physiotherapy showed that, the Constant score in the subgroup of patients who received physiotherapy as subscribed by a physician had better results than the subgroup of patients who did not receive physiotherapy as recommended by the physician. In this cases the Physiotherapist used a protocol which was not recommended by the physician. Physiotherapy in accordance with the physician's orders (n = 33) was associated with an increase in the Constant score from 64.2 ± 2.6 to 88.4 ± 2.5 ($p < 0.001$) during the follow-up period of 12 months. By contrast, physiotherapy that was not provided as ordered (n = 7) was associated with a lower increase from 57.6 ± 5.7 to 78.4 ± 5.3 ($p < 0.001$). The difference between the two subgroups was, however, not significant. The improvement in the Constant score from the beginning of treatment (64.2 ± 2.6) to the 3-month (78.5 ± 2.4), 6-month (84.8 ± 2.5) and 12-month follow-up (88.4 ± 2.5), however, was significant in the subgroup of patients who received physiotherapy as ordered by a physician. In the subgroup of patients who underwent physiotherapy that did not adhere to treatment recommendations, a significant increase in the Constant score was observed only after 12 months (57.6 ± 5.7 to 78.4 ± 5.3).

Level of pain

There was no significant difference in pain intensity between conservative and surgical treatment groups as measured on the basis of the Numerical Rating Scale (NRS). After the first period of treatment, pain significantly decreased in both groups after 3, 6 and 12 months (Fig. 3).

A subgroup analysis showed that the patients who underwent physiotherapy as recommended by the protocol of the physician reported lower levels of pain than the patients who did not receive physiotherapy as recommended. In the conservative treatment group where the physiotherapist followed our instructions, pain ratings decreased from 3.1 (± 0.1) at the beginning of treatment to 1.8 (± 0.2) after 12 months ($p < 0.001$). The subgroup where the physiotherapist ignored our instructions pain levels decreased from 3.4 (± 0.3) to 2.3 (± 0.4) ($p = 0.002$). The difference between the two groups was not significant. A significant improvement in pain after 6 months was observed only in patients who received physiotherapy as recommended 3.1 (± 0.1) to 2.5 (± 0.1) ($p < 0.001$).

Inability to work

Three months after starting therapy, the conservative treatment group showed significantly better results in terms of ability to work. After the beginning of treatment, the surgical treatment group showed an increase in the duration of inability to work at 3-month follow up. This duration, however, significantly decreased in the period of the following 3 months (month 4 to 6) and was found to be similar to that reported for the conservative treatment group in the period from month 7 to 12 (Fig. 4).

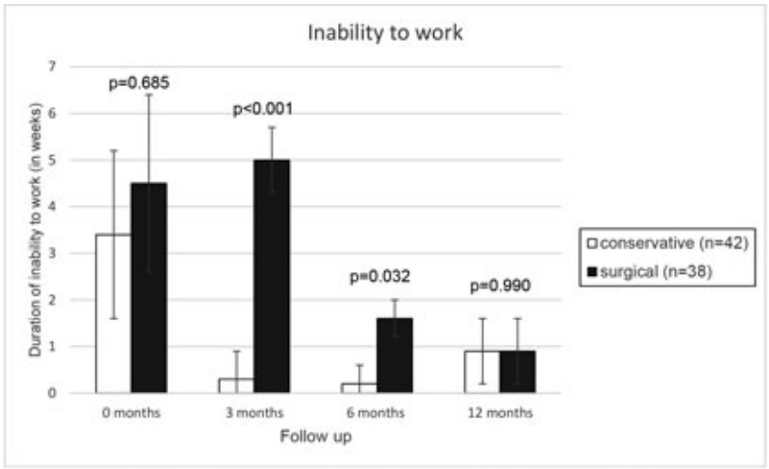
There was no relevant difference in the duration of inability to work between the subgroups of patients who either performed physiotherapy as recommended or not. At 6-month follow-up, however, the success of physiotherapy as recommended was significantly higher than that of physiotherapy that did not correspond to treatment recommendations (from the beginning of treatment to 3-month follow-up: 0.3 ± 0.3 versus 1.1 ± 0.6 weeks, $p = 0.171$; 4 to 6 months: 0.0 ± 0.1 versus 0.4 ± 0.2 weeks, $p = 0.028$; 7 to 12 months: 0.7 ± 0.7 versus 0.9 ± 1.5 weeks, $p = 0.936$).

DISCUSSION

Shoulder pain is the second frequent common musculoskeletal problem (after back pain) in Europe (10). Impingement is the most common reason for shoulder pain (9, 14). Many studies do not distinguish between different aetiologies of this pain syndrome. Unlike most of the literature, our study specifically addresses primary extrinsic impingement. Different treatment options are

described in the literature which, however, are not tailored to specific aetiologies. Conservative treatment is usually attempted first (11). The most important non-operative options are non-steroidal anti-inflammatory drugs, corticosteroid injections, and physiotherapy (5, 19). Djordjevic et al. successfully treated patients with Kinesio taping, electrotherapy and manual therapy (6). In the study presented here, conservative treatment consisted of physiotherapy elements and, if indicated, injections.

The surgical treatment of choice is arthroscopy combined with the removal of possible causes of narrowing of the subacromial space and subacromial bursectomy (16, 17). Good outcomes have been reported for both conservative and surgical options (1, 3, 11). In the study presented here, significant improvements in function (Constant score) and pain (NRS) were also achieved in both treatment arms. There were no significant differences between the two groups at any time point. These results are similar to those reported by other authors in recent studies (11, 18).



Conservative treatment	At the beginning of treatment	At 3 months	At 6 months	At 12 months
At the beginning of treatment	x	0.065	0.071	0.077
At 3 months	x	x	0.812	0.413
At 6 months	x	x	x	0.201
At 12 months	x	x	x	x
Surgical treatment				
At the beginning of treatment	x	0.768	0.118	0.016
At 3 months	x	x	< 0.001	< 0.001
At 6 months	x	x	x	0.263
At 12 months	x	x	x	x

Fig. 4. Assessment of the duration of inability to work because of subacromial impingement syndrome before study inclusion (0 months), at 0 to 3 months (at 3 months), at 4 to 6 months (at 6 months) and at 7 to 12 months (at 12 months) after study inclusion and effects (p-value) within treatment groups (below the column bar chart), adjusted for age, body mass index (BMI) and sex.

Unlike other research work, however, our study demonstrated a major difference in the development and duration of inability to work. We detected this effect at 3-month and 6-month follow-up assessments in a smaller sample of patients (23). Apart from treatment costs, inability to work is an important factor in an evaluation of the cost-effectiveness of treatment (12).

In the literature, there is a paucity of data on the patients' inability to work after the surgical management of a shoulder disorder. In a Danish study, 9.8% of patients who were in the labour market at the time of hospital admission became permanently unable to work within two years of surgery for health reasons (24). In a retrospective Belgian study from 2011, patients who underwent arthroscopic subacromial decompression (ASD) were fully able to return to work after a mean period of 11.1 weeks (15).

The earliest return to work was reported for self-employed patients who resumed working after a median period of one week. There was no significant difference between patients with statutory health insurance and those with private health insurance. Patients who performed manual work were absent from work for a significantly longer period of time than other patients (12 versus 8 weeks) (15). Longer absence from work was also reported for patients who underwent both ASD and arthroscopic acromioclavicular joint resection and patients with a higher BMI (15).

Our findings suggest that conservative treatment helps patients return to work earlier. At 3-month follow-up, the conservative treatment group had significantly better results in terms of return to work than the surgical treatment group, which showed an initial increase in inability to work. There was no difference between the two groups in ability to work during the period from 6 to 12 months following treatment. Treatment that focused on the functional deficit that had been diagnosed by a physician was found to lead to considerably better results for all investigated parameters. This emphasises that a structured and targeted approach based on the provision of treatment as prescribed by a physician is essential for treatment success and that physicians must ensure that treatment adherence is maintained.

A methodological strength of this study is that it is based on a relatively homogeneous group of patients. In accordance with Beirer et al. (2), patients with concomitant pathologies such as supraspinatus tears and pathologic changes in the tendon of the long head of the biceps were excluded. This is the reason for prolonged time of recruitment. Depending on whether it was possible to provide conservative treatment in accordance with the study protocol, patients were assigned to one of the two treatment arms. This means that a limitation of this study is that patients were not randomly assigned to a form of treatment and that there was no placebo intervention. In addition, the sample size was too small to allow the advantages of conservative treatment in accordance with the physician's orders to be demonstrated more clearly. Initially we had not intended to analyse differences in conservative treatment. This resulted from the detected

lack of compliance on the part of the physiotherapists. The analysis of these differences and the knowledge that all patients had undergone conservative treatment prior to study inclusion emphasise the importance of conservative treatment that is specifically tailored to each patient's functional problem. Although the subgroup analysis presented here is of limited value as a result of the small sample size, our study suggests that individualised physiotherapy that is provided by physicians and physiotherapists in a coordinated effort plays a key role in treatment success.

CONCLUSIONS

At 3, 6 and 12 months after the beginning of either conservative or surgical treatment, patients with primary extrinsic impingement syndrome showed similar outcomes in terms of shoulder function (Constant score) and pain (NRS). The duration of inability to work was shorter in patients who were treated conservatively. In addition, conservative management is not associated with the risks and costs of surgical treatment. Targeted and structured conservative treatment requires an appropriate analysis of the functional problem which enables physicians to prescribe treatment that is tailored to the needs of each individual patient and should be provided by a physiotherapist in a compliant manner. Additional treatments, such as injections, are effective in the management of bursitis and acromioclavicular joint osteoarthritis. An arthroscopic procedure may be considered after failed systematic conservative treatment. Our data are consistent with the current opinion that patients with primary extrinsic impingement and no structural damage to the tendon should initially be treated with conservative care.

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