

Profile of Major Ligament Injuries of The Knee in Patients at Indonesia Tertiary Referral Hospital



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Received: 2024-08-13
Accepted: 2024-10-22
Published: 2024-11-18

ABSTRACT

Background: The knee joint is supported by four major ligaments: the ACL, PCL, MCL, and LCL. Injuries to these ligaments often occur during physical activities like sports and transportation, particularly in young men.

Objective: This study aimed to determine the profile of patients who suffered from major knee ligament injuries at Dr. M. Djamil Padang Hospital between 2018 and 2020.

Methods: This is a descriptive study that utilizes a total sampling design. Data was collected from medical records, and variables were based on sex, age, mechanism of injury, side of injury, and therapy options.

Results: The study included 130 patients with major ligament injuries and underwent MRI examinations. Among these injuries, ACL occurred in 123 cases (80.39%), 22 PCL cases (14.38%), 7 LCL cases (4.58%), and 1 MCL case (0.65%). The incidence of these injuries was more common in men, with 102 patients (78.46%) than women, with 28 patients (21.54%), and predominantly occurred in the age group of 18-35 years, with 84 patients (64.62%). The majority of patients (66.92%) suffered injuries while participating in sports such as football, basketball, skateboarding, badminton, and martial arts. The right knee was more frequently injured (56.9%), and 89.5% of the patients underwent reconstruction surgery, followed by physiotherapy.

Conclusion: According to the study, the ACL (anterior cruciate ligament) is the most frequently injured body part, usually in men aged between 18 and 35 years. The primary cause of the injury is trauma during sports, and the right knee is the most commonly affected side. Out of 130 patients, 89.5% underwent reconstructive surgery through arthroscopy.

Keywords: ligament injury, knee joint, Anterior Cruciate Ligament, Posterior Cruciate Ligament, Medial Collateral Ligament, Lateral Collateral Ligament.

Cite This Article: Rahmadian, R., Afriani, N., Ifan., Ariliusra, Z. 2024. RProfile of Major Ligament Injuries of The Knee in Patients at Indonesia Tertiary Referral Hospital. *Indonesia Surgical Journal* 1(2): 31-37

INTRODUCTION

The knee is the largest joint in the human body, with a complex structure consisting of the tibiofemoral and patellofemoral joints.^{1,2} This joint has a structure to maintain stability in the knee, especially the four major ligaments in the tibiofemoral joint, namely the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), medial collateral ligament (MCL) and lateral collateral ligament (LCL) accompanied by the structure of bones, muscles, meniscus, and cartilage in the knee. The ACL and PCL ligaments prevent excessive movement of the tibia towards the front and back, while the MCL and LCL maintain excessive adduction and abduction movements in the knee joint.³

Knees are susceptible to injuries due to frequent contact with the external environment. This is primarily caused by increased physical activity, including driving and participation in contact and non-contact sports, especially among young people.^{3,4} Research conducted by Sheffield et al. has confirmed 1833 injuries to the body, with the knee joint being the most commonly injured part, accounting for 40% of all major ligament injuries, 24% of patella injuries, 11% of meniscus injuries, and 25% of a combination of these injuries.⁵

According to research conducted in Italy in 2019, major ligament injuries of the knee follow a typical pattern. ACL injuries are the most common, accounting for 49% of cases.⁶ MCL injuries are the second most common, making up 20%

of cases. LCL injuries account for 4.2% of cases, while PCL injuries are only 1%. The remaining cases involve a combination of four ligaments, particularly injuries to both the ACL and MCL due to their similar biomechanics and protective function in guarding the knee against valgus stress, external rotation, and forward translation.^{5,7-11}

Numerous studies conducted abroad also reveal that ACL injuries are the most frequent, which is why many researchers give it more attention. MCL injuries come in second, while PCL and LCL injuries are uncommon because PCL is the strongest ligament in the human body and requires substantial pressure to be injured. Injuries due to PCL and varus stress mechanisms, such as kicking from the inside of the knee, are rare in sports and while driving. Knee

ligament injuries often occur on the right side as the dominant side due to the high level of use as a body weight supporter and kicker in several sports, so there is a greater risk of injury.^{9,10,12} Data from research results conducted by Kardi et al. at Sanglah Hospital, Bali, in 2018-2019 reported the number of patients diagnosed with major ligament injuries of the knee joint, often occurring in 78% of men, especially at young ages.¹⁰ The mechanism of injury that causes major ligament injury is often low energy/non-contact (56.3%), such as sudden deceleration with a combination of movements changing direction quickly/ suddenly, landing movements with the knee being extended, or trauma that causes the tibia to translate forward or rotation in high-stress joints. In contrast, high energy/contact injury mechanisms occur when there is direct contact such as injuries resulting from traffic accidents, being tackled by opposing players, colliding with objects.^{7,9,13}

Treatment for major knee ligament injuries has several options based on the type of ligament and severity of the injury. ACL and MCL injuries have the choice of treatment in the form of surgery because there is an increase in the subjective score from the International Knee Documentation Committee (IKDC), and they are considered to reduce instability. In contrast, for PCL and LCL injuries, non-operative therapy is chosen in the form of conservative and combined with quadriceps muscle rehabilitation.^{6,14} Management In injuries, you must also consider the intra-articular or extra-articular ligament because intra-articular ligaments such as the ACL and PCL are surrounded by enzymes in the fluid, which have the property of inhibiting collagen repair in the ligament, so they have low repair ability compared to the MCL and LCL as extra-articular ligaments. However, the theory in Apley and Salomon's book concludes that management of all major ligaments of the knee can start with physiotherapy, especially on quadriceps muscle strength, because it is considered to be able to restore the patient's performance almost to the same condition as before the injury. In contrast, if there is persistent instability with real patient complaints, surgery can be selected.³

Patients with major ligament injuries with failed management or high levels of severity have pathologies that often coincide, namely meniscus and cartilage injuries, so there is a risk of developing osteoarthritis resulting in walking problems and can affect the patient's psychological state, especially for the career of an athlete.¹⁵⁾

METHOD

This descriptive study collected secondary data from the medical records of all patients with major knee ligament injuries at RSUP Dr. M. Djamil Padang for the period January 2018 - December 2020 with inclusion criteria, namely patients with medical record data who were diagnosed with major ligament injury of the knee, namely ACL, PCL, LCL, MCL who had been diagnosed with MRI and exclusion criteria, namely incomplete medical record data such as no include gender, age, treatment options in the medical record. The ethical clearance number for this research is No: 211/KEP/2021, and the institution that issued the ethical clearance number for this research is the Health Research Ethics Committee of Dr.M.Djamil Hospital Padang.

RESULT

Distribution of Injury Frequency Based on Type of Major Ligament of the Knee Joint

The results of research on the injury profile of patients with major ligament injuries in the knee joint based on the type of major ligament at Dr.M.Djamil Hospital Padang in 2018–2020 can be seen in [Table 1](#).

[Table 1](#) shows 153 total injuries to all types of major knee ligaments from 130 patients, with 16 patients diagnosed with more than one ligament. The major ligament most frequently injured was the ACL in 123 patients (80.4%), while the MCL was only one patient (0.6%). This data also includes results from several patients who had injuries to more than one ligament, namely 11 patients with a diagnosis of ACL along with PCL, one patient with ACL and LCL, one patient with PCL and MCL, one patient with bilateral ACL and two patients with combined ACL, PCL, and LCL.

Distribution of Injury Frequency Based on Age

Age distribution at diagnosis of significant ligament injury in patients at RSUP Dr. M. Djamil in 2018–2020 can be seen in [Table 2](#).

Table 1. Frequency Distribution of Injuries to the Major Ligament of the Knee Joint Based on the Type of Major Ligament of the Knee

Type	f (n=153)	%
ACL	123	80.4
PCL	22	14.4
MCL	1	0.6
LCL	7	4.6
Total	153	100

Table 2. Frequency Distribution of Major Ligament Injuries Based on Age at Diagnosis

Age	f (n)	%
<18 years old	19	14.6
18-35 years old	84	64.6
35-65 years old	27	20.8
>65 years old	0	0
Total	130	100

Table 2 shows the distribution of patients with injuries that often occur in the young age group between 18-35 years with a total of 84 patients (64.6%), and the least frequent age group is the 36-65 year age group with a total of 27 cases (20.8%). This study found no incidence of injury in people over 65 years of age (0%). This study also recorded that the average age of patients was 27 years, with the youngest age injured being 14 years and the oldest being 58 years.

Frequency Distribution of Major Ligament Injuries Based on Gender

This study shows that the distribution of patients who experienced major ligament injuries in the knee joint was more male, with 102 patients (78.5%) with a ratio of up to 8:2 (**Table 3**).

Frequency Distribution of Major Ligament Injuries of the Knee Joint Based on the Side of the Knee

The side of injury to each ligament, which describes the distribution of injuries to the major ligament of the knee joint, was found to occur more frequently on the right/dominant side in 87 patients (55.9%).

Frequency Distribution of Major Ligament Injuries of the Knee Joint Based on Injury Mechanism

Table 5 describes the distribution of patients with a major ligament injury diagnosis based on the injury mechanism. This study found that more patients experienced injuries from participating in various sports, with 87 patients (66.9%).

Frequency Distribution of Major Ligament Injuries of the Knee Joint Based on Treatment Choices

Table 6 shows that patients with major ligament injuries in this study preferred operative treatment, with the total number of operations being 137 ligaments (89.5%). The results of this study recorded the types of ligaments that underwent operative reconstruction via arthroscopic procedures, namely 107 patients with ACL injuries, 22 patients with PCL injuries, seven patients with LCL injuries, and one with MCL injuries.

Table 3. Frequency Distribution of Events According to Patient Gender

Gender	f (n)	%
Male	102	78.5
Female	28	21.5
Total	130	100

Table 4. Frequency Distribution of Events According to Side of Knee

Side of the knee	ACL	PCL	MCL	LCL	n	%
Right	64	15	1	7	87	55.9
Left	59	7	0	0	66	44.1
Total	123	22	1	7	153	100

Table 5. Frequency Distribution of Events According to Cause of Injury

The cause of injury	f (n)	%
Sports	87	66.9
Non Sports	43	33.1
Total	130	100

Table 6. Frequency Distribution of Treatment Options for Knee Ligament Injuries

Treatment	ACL	PCL	MCL	LCL	f (n)	%
Surgery	107	22	1	7	137	89.5
Non Surgery	16	0	0	0	16	10.5
Total	123	22	1	7	153	100

DISCUSSION

Distribution of Injury Frequency Based on Type of Major Ligament of the Knee Joint

This study included 130 patients with major ligament injuries of the knee joint in 2018–2020, with a total of 153 major ligament injuries in both the left and right knees. The results of this study found that the highest injury rate occurred in the ACL, both partial and total, with 123 injuries (80.4%), PCL with 22 injuries (14.4%), LCL with seven injuries (4.6%) and the lowest incidence was MCL which only amounted to 1 injury (0.6%). This research data shows that the ACL injury rate is the highest, followed by PCL, LCL, and MCL, which have fewer injury rates. Because the incidence of ACL injuries is

the most common, researchers say there will be many other extensive studies focusing on preventing and managing ACL injuries in the future.^{6,9,10}

The results of this study are in line with the results of research conducted at the Royal Victoria Hospital in England, which noted that injuries within one year were ACL injuries which were the most common, namely 230 patients (46%), followed by MCL injuries as the second most common with 145 patients (29%) and the incidence of PCL and LCL is less than 5% per year.⁷ Research by John R. from India in 2016 obtained the same results as research conducted in England namely ACL injuries were the most common with 314 patients, followed by MCL with 93 patients, while the incidence of LCL was 40 patients and PCL was ten patients.¹²

The difference in this study is that it lies in second place in terms of the highest number of incidents. PCL injuries are the second most common after ACL, while other studies state that MCL injuries are the second most common after ACL. The researchers assessed that based on research by Ahmed Ali regarding the biomechanics and main injury mechanisms of the greater ligament of the knee joint, this difference was caused by the fact that in a total of 130 patients, little or almost no injury mechanism was found in the form of valgus stress or lateral rotation which is the main injury mechanism to the MCL.¹⁶

The injury mechanism is more likely to occur in posterior translation or hyperflexion with a large force, the main injury mechanism in the PCL, often caused by extreme contact injuries such as traffic accidents, including dashboard injuries or extreme contact in certain sports.³⁸ Theories that support this idea also come from research conducted by Pache and Logterman, which stated that the PCL is the strongest ligament in the human body. Hence, injuries rarely occur in trauma with low pressure.^{14,17}

Distribution of Injury Frequency Based on Age

Patients with major ligament injuries in the knee joint were most often found at the age of 18-35 years; they are 84 patients (64.62%), followed by the age group between 35-65, namely 27 patients (20.77%), and 19 patients (14.62%) in the group under 18 years of age and not found in the age group over 65 years. The youngest patient who was injured was 14 years old, and the oldest patient was 58 years old.

These results align with research conducted at Sanglah General Hospital, Bali, which stated that major ligament injuries in the knee joint often occur at a young age because they have a more active activity level than old age, especially in sports and transportation such as driving.⁸ Research by Mardani in Iran also stated that young men more often experience injuries to the major ligament of the knee joint, which is caused by men's more active activity patterns compared to women from various aspects of life such as working, extreme sports and driving.⁹

Results Research by Neil at the University of Michigan's Orthopedics Department found that the distribution of injuries to the greater ligament of the knee is often found at a young age, with an average age of 25 years.¹⁸

The majority of patients were young, with the mechanism of injury being 66.9% in sports and 33.1% in non-sports, such as falls due to driving.

Injuries often occur at a young age, with the majority of patients having injury mechanisms that are consistent with other studies, namely trauma from participation in various types of sports and other risks, such as driving on the road. Research by Filbay in 2019 supports this idea, stating that young people tend to have behavior that is less alert to the possibility of a knee injury, such as reckless activities on the road, participating in challenging sports, and being emotionally unstable, so they often get or give contact. physically with opponents playing in the sports of football, basketball, silat, wushu, and karate.¹⁹

Frequency Distribution of Major Ligament Injuries Based on Gender

Major ligament injuries in the knee joint at Dr. M. Djamil General Hospital in 2018-2020 mostly occurred in men, 102 patients (78.46%), while in women, there were only 28 patients (21.54%). In Indonesia, this aligns with research conducted at Sanglah General Hospital, Bali, which states that men experience knee injuries more often because they have a higher level of sports participation and activities on the road than women.⁸ The results of this study are also in line with research in the Oslo Hospital in Norway, which stated that the incidence of major ligament injuries in the knee joint had a ratio of up to 65:35 in men and women.¹⁵

This research found that the incidence of injuries often occurs in men because of risk factors for participation in sports and the majority of vehicle drivers on the road are men, and if there is pressure or trauma to the joints in the knee, especially the greater ligament as a guard or the main stability of the knee will be at risk of injuring the major ligament. Researchers also concluded that of the 28 female patients who suffered injuries, only six suffered injuries from participating in

sports. In comparison, 22 patients suffered injuries from falls on slippery surfaces, bicycles, and traffic accidents. From this data, researchers can conclude that major ligament injuries in the knee joint occur more often in men due to the tendency of male patients to have a high level of sports activity, especially contact sports such as football, basketball, and silat.

Frequency Distribution of Major Ligament Injuries of the Knee Joint Based on the Side of the Knee

This study found that the location or side that experienced major ligament injury in the knee joint was more common on the right side as the dominant side, namely 89 cases (55.6%), while the left knee was 65 cases (44.4%). These results are in line with research in 2019 in Sweden, which noted that injuries often occur on the dominant side, namely the right leg, because it is more often used as a kicker and body support in patients who suffer injuries due to sports with a total of 65% of 117 patients.²⁰ Research by Lundblad et al. also states that injuries to the major ligament occur in the right leg or the dominant leg, which is more actively used for activities, holding movements, and sports, including martial arts.⁹ However, the result of this study is different from research in Bali in 2020, which states that the incidence of ACL injuries often occurs on the left side as the non-dominant side, namely 56.3% due to the lower strength of the quadriceps muscle as a support for the major ligament in the knee joint compared to the right side which is the dominant side.¹⁰

The researchers analyzed that the injury rate based on the side of the knee had small differences. Hence, the researchers considered several possible analyses regarding the side of the knee that is more likely to experience injury. The incidence of injury to the side of the knee will depend on several things, especially the type of contact or non-contact sport that the patient plays. In contact sports such as football and basketball, the side that is injured is the side that experiences trauma due to contact with an opposing player, so it cannot be predicted which side will experience injury. In contrast, in non-contact sports such as volleyball, running,

and badminton, it can be expected that the side of the knee that is more at risk of injury is the leg often used for leaning, turning, and moving. Researchers also analyzed and found that differences in assessments regarding the incidence of the side of the knee that was injured were not only based on muscle strength, which is an active stabilizer of the knee, but also the mechanism of trauma that affected the side of the knee such as dashboard injuries, hyperextension, hyperflexion, extreme rotation, and varus or valgus stress in both sports-related trauma and non-sports trauma such as falls and traffic accidents.

Frequency Distribution of Major Ligament Injuries of the Knee Joint Based on Injury Mechanism

This study obtained distribution results based on the causes of trauma from sports, namely 87 patients (66.9%) and 43 patients (33.08%) from non-sports. This result is a conclusion from medical record data, including the patient's answers to the assessment during the anamnesis. Research notes that exercise is the cause of major ligament injuries in patients at Dr. M. Djamil Hospital Padang: football, basketball, badminton, skateboarding, silat, muay Thai, and wushu. In contrast, the causes of non-sports injuries are traffic accidents and falls and slips on the road or floor.

The results of this study are supported by the results of research conducted by Lundblad et al., which stated that injuries to the major ligament of the knee joint, especially the ACL and MCL, often occur in patients who participate in sports, especially football.¹¹ This research obtained results in line with those conducted by Schram et al., which concluded that knee ligament injuries often occur in patients who participate in sports, especially in competitions with a risk of injury, namely when fatigue occurs resulting in reduced neuromuscular control which results in reduced proprioceptive abilities and leads to falls or injury.⁴

This study only groups the causes of injury based on sports and non-sports causes, so it does not describe the mechanism of injury in patients, especially the type of injured ligament. Patients who

reported injuries in the field of sports were categorized as causes of sports trauma with the sports field recorded, namely 45 patients injured in football, five patients due to playing basketball, four patients with participation in the martial arts fields of wushu and muay thai and silat while the rest were recorded the medical only wrote "trauma due to sports". The researchers analyzed that categorizing injury mechanisms based on sports and non-sports produced data showing that "the largest number of injuries were due to sports." Besides, these results provided information that injuries had occurred in patients who participated in contact sports such as football, soccer, basketball, silat, wushu, muay thai, and karate. Meanwhile, badminton and running are categorized as non-contact sports.

Researchers analyzed that this study's injury mechanisms in patients with major ligament injuries could not describe specific mechanisms such as dashboard injuries in PCL injuries, varus and valgus stress in LCL and MCL injuries, anterior translation, and hyperextension in ACL injuries. Researchers could only analyze that in 130 patients with 153 ligament injuries, there were 109 injuries to the ACL with a possible anterior translation injury mechanism, 8 PCL injuries with a posterior translation injury mechanism, and 0 injuries to the MCL alone, which means that there was no valgus stress injury mechanism in 130 patients. In this study, 4 LCL injuries with a pure injury mechanism of varus stress.

In combined injuries, researchers analyzed 11 combined injuries between ACL and PCL with an anterior translation injury mechanism and tibia hyperextension, two combined injuries between ACL, PCL, and LCL with an extreme varus stress injury mechanism, one combined injury between PCL and MCL with a rotational injury mechanism external/lateral, one combined injury between LCL and ACL with a reasonably large varus stress injury mechanism. The researcher's analysis of the possible mechanisms of this injury is the result of research conducted by Ahmed Ali regarding specific injury mechanisms that pose a risk of injuring each ligament, whether they occur independently or

simultaneously.¹⁶

The mechanism of ACL injury is hyperextension, which occurs when the tibia experiences excessive forward translation, which causes the ACL to experience extreme tension, resulting in injury. Usually, the mechanism of ACL injury is non-contact injury (70%), such as falls and sports that require sudden twisting and changing direction or landing with the knee fully extended. The PCL injury mechanism is known as a dashboard injury when there is direct pressure on the tibia towards the back when the knee is flexed or hyper-flexed. This injury mechanism is called a contact injury mechanism (trauma), such as when in contact with a playing opponent or object, with examples of causes being hit, kicked, or tackled; while injuries resulting from turning or turning direction are classified as non-contact injuries at 18.2%.

The mechanism of injury to the MCL is valgus stress with pressure coming from the lateral/outside of the knee, thereby providing extreme tension and injuring the MCL. Meanwhile, the mechanism of LCL injury is purely varus stress with the pressure coming from the extreme medial direction of the knee.^{9,13}

Frequency Distribution of Major Ligament Injuries of the Knee Joint Based on Treatment Choices

The results of research regarding management options for patients with major ligament injuries in the knee joint provide an illustration that operative treatment is more often chosen in managing patients with major ligament injuries in the knee joint, which was carried out in 114 patients (87.69%) than those who underwent non-operative treatment only as many as 16 patients (12.31%).

In the patient's complete medical record, an operative report states that operative management was carried out via arthroscopy with a small incision in the knee. The operation begins with taking a graft on the gracilis and semitendinosus tendons and then placing the graft via arthroscopy to reconstruct the injured ligament. In patients who underwent non-operative management, the medical records recorded the actions carried out

in physiotherapy ten times with exercises such as graded mobilization, strengthening quadriceps and hamstring muscles such as cycling, ultrasound, and transcutaneous electrical nerve stimulation (TENS).

The result of this study is in line with research at Chandigarh Hospital in India, which stated that 69.6% of 457 patients with major ligament injuries of the knee joint received operative management. At the same time, the rest were treated conservatively through bracing and physiotherapy.¹² The results of this study are also the same as those of research in Sudan, which states that the majority of patients prefer surgical management. In contrast, conservative management is chosen when there is a patient's condition that cannot tolerate surgery, consideration of the healing ability of the ligament, especially extra-articular ligaments such as the MCL and LCL, patient refusal of surgery, risk of infection, lack of resources in operation.¹⁶

Research conducted by Jannelli et al. states that management of major ligament injuries of the knee joint is chosen based on empirical evidence, such as surgical management, which is the gold standard for ACL injuries, especially in young patients. However, some recommend rehabilitation until the knee reaches 90° in flexion and surgery is performed. Treatment of the ACL in the form of surgery can speed up the patient's return to normal activities, such as sports, within six months after surgery and is considered to reduce the risk of knee instability. In third-degree (high) MCL and LCL injuries, namely >10mm laxity in valgus and varus stress, it is almost always found simultaneously as an ACL injury, so immediate operative treatment is required.⁶

Researchers analyzed the choices in patient management at RSUP Dr. M. Djamil. Surgery is chosen in several situations, such as ACL, as the gold standard treatment. There are natural functional disorders, such as complaints from patients who often complain of knee pain and wobbling when walking, considering the empirical evidence regarding the healing ability of extra-articular ligaments such as the MCL and LCL, which is quite good, especially in

grades 1 and 2. Surgery is chosen to restore the knee structure, hoping to achieve pre-injury performance. The theory that supports the researchers' analysis comes from Apley and Salomon's book, which states that injuries to the ACL and PCL can be managed with good quadriceps rehabilitation and proper movement control so that patients can return to their regular activity, even sports.

Meanwhile, surgical intervention is chosen for patients with ACL and PCL injuries with persistent instability with clear complaints to prevent the risk of other pathologies as complications, such as injury to the cartilage and meniscus in the knee joint. This book also states that the treatment option for MCL and LCL injuries can be done with bracing to maintain ROM because this ligament is an extra-articular ligament with good spontaneous healing ability. In contrast, operative management will be chosen in patients who have received conservative management but have persistent instability.³

CONCLUSION

The knee joint is held together by four major ligaments: the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), medial collateral ligament (MCL), and lateral collateral ligament (LCL). Sports injuries are one of the most common risk factors that can cause damage to these ligaments, with the ACL being the most commonly injured one. It is worth noting that ligament injuries are more frequently observed in the dominant side of the body, causing more harm to the right knee joint. In cases where surgical intervention is necessary, the most common treatment method used is arthroscopic reconstruction, which accounts for 89.5% of all knee ligament injury treatments in this study.

SUBMISSION STATEMENT

The authors represent that this submission is original work and is not under consideration for publication in any other journal

FUNDING

The authors declared that this article has received no financial support.

CONFLICT OF INTEREST

All authors have no conflict of interest to declare

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