ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 8, Issue, 12, pp. 22824-22829, December, 2017

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

MRI STUDY OF THE "ANTEROLATERAL LIGAMENT OF THE KNEE": APPEARANCE, TEARS AND ITS ASSOCIATION WITH OTHER INTERNAL DERANGEMENTS OF THE KNEE

***Anita Soundarapandian[1]., Manoj Kumar Balasundaram[1]., Natarajan Shanmugam[2]., Seena Cheppala Rajan[1] and Saveetha Veeraiyan[1]**

[1]Department of Radiodiagnosis, Saveetha Medical College and Hospital, Chennai, India
[2]Department of Orthopedics, Saveetha Medical College and Hospital, Chennai, India

DOI: http://dx.doi.org/10.24327/ijrsr.2017.0812.1343

ARTICLE INFO

Article History:

Received 17th September, 2017
Received in revised form 21th October, 2017
Accepted 28th November, 2017
Published online 28th December, 2017

Key Words:

Anterolateral ligament, anterior cruciate ligament, lateral meniscus, strain, partial tear, complete tear, non visualization, avulsion.

ABSTRACT

Introduction: Various ligaments, menisci and retinaculae are reported in an MRI of the knee joint coming for a suspected internal derangement of knee. The contributory role of the anterolateral ligament (ALL) in maintaining knee stability however has not been adequately studied as yet, and therefore not routinely reported.

Purpose: To assess MRI appearance of this anterolateral ligament (ALL), its femoral, meniscal and tibial components and attachments. And to evaluate its associations with other internal derangements of the knee like anterior cruciate ligament (ACL) tear and meniscal tear.

Materials and methods: A total of 25 MRI knee studies interpreted as normal will be reviewed to characterize the anterolateral ligament.

A further 25 MRI knee with internal derangement injuries will be studied to assess the association of ALL with other internal derangements.

Patients referred for knee MRI with clinically suspected internal derangements will be included in this study. Patients suffering from claustrophobia, incompatible metallic hardware and post-operative knee patients were excluded from the study.

Results: Among the 25 patients whose MRI was normal, the anatomy was fairly established and correlated with prior studies. The femoral attachment was seen to merge with the anterior aspect of the fibular collateral ligament in all cases.

Among the 25 patients who were diagnosed with MR of having various internal derangements, the largest association was found to be with anterior cruciate ligament injuries. One patient with a bucket handle tear of the body of lateral meniscus had a complete tear of the ALL. Further one patient with a Segond's fracture had a tibial avulsion of the ALL.

Conclusion: With this study, we were able to more assertively establish the anatomy and attachments of the relatively unexplored anterolateral ligament.

The anterolateral ligament injuries were found to have a strong association with tears of the anterior cruciate ligament, flipped tears of the body of lateral meniscus as well as Segond's fracture.

BACKGROUND

The anatomy of the knee joint is quite complex with numerous structures providing stability. The medial and lateral collateral ligaments, anterior (ACL) and posterior cruciate ligaments, the medial and lateral menisci, medial and lateral patellar retinaculae, along with the shape of femur and tibial condyles play a very important role in keeping the knee joint in its proper alignment. All these ligaments and structures are assessed and routinely reported in every knee MRI study.

Recently, there has been much excitement and an ongoing debate about the existence of a structure which was first described by Dr. Paul Segond in 1879 as a 'pearly, resistant, fibrous band which invariably showed extreme amounts of tension during forced internal rotation of the knee'[1].

Anterolateral ligament (ALL) is a ligament which is said to be present in the lateral aspect of knee anterior to the lateral collateral ligament and also plays an important role in providing rotational stability to the knee joint along with ACL. It is uncertain if an isolated anterolateral ligament injury with an intact anterior cruciate ligament injury leads to knee

Corresponding author:* **Anita Soundarapandian
Department of Radiodiagnosis, Saveetha Medical College and Hospital, Chennai, India

instability. However, the appearance of ALL and its relationship to other internal derangements of the knee are not usually included in a routine knee MRI report.

It is important to recognize that even in the best of circumstances a small, but sizeable, percentage of patients, ranging between 5% and 15%, still have some instability after suffering an ACL tear and after undergoing an ACL repair / reconstruction [9]. There are many issues that could possibly be the cause for this; and one of them could be the anterolateral ligament. The anterolateral ligament may have some role in providing additional rotational stability to the knee.

We believe that further studies will be necessary to define if this is something that could be diagnosed in patients who have ACL tear or other internal derangements.

Aims and objectives

This study is to provide an outline about this anterolateral ligament and its importance in including it in a routine MRI report.

The purpose of this study is to know the MRI appearance of this anterolateral ligament, its femoral, meniscal, tibial components, its insertion, origin and its associations with other internal derangements of the knee like ACL tear and meniscal tear.

MATERIALS AND METHODS

The study has been conducted at Saveetha Medical College and Hospital after obtaining permission from Institutional ethical committee of Saveetha University.

A total of 25 MRI knee studies interpreted as normal were reviewed to characterize the anterolateral ligament.

A further 25 MRI knee with internal derangement injuries were studied to assess its association with other internal derangements.

Male and female patients coming for knee MRI with clinically suspected internal derangements will be included in this study. Patients suffering from claustrophobia, incompatible metallic hardware and post-operative knee patients were excluded from the study.

Anterolateral ligament tear was recognized as increased signal intensity or discontinuity of its fibers or complete non-visualization of its fibers. Its femoral, lateral meniscal and tibial attachments were studied.

An informed consent was obtained prior to the study after explaining the procedure of the examination to the patient. The examinations were carried out in a Philips 1.5 TESLA MRI machine. MRI sequences include high resolution, thin slices, proton density weighted axial, sagittal, coronal planes.

The ALL was evaluated on thin (2.5mm slice thickness), high resolution, coronal and axial images and categorized as intact or torn. If it was intact its anatomic characterization was done. And if it was torn its association with other internal derangements were looked into. We classified injury as strain if there was increased signal without definite tear, partial tear, complete tear and non visualization (complete or partial).

The involvement of ALL with other internal derangements of the knee were documented and a conclusion was made with the help of statistical analyses.

A BRIEF REVIEW OF LITERATURE

It was in 1879, that the French surgeon Segond described the existence of a 'pearly, resistant, fibrous band' at the anterolateral aspect of the human knee, attached to the eponymous Segond fracture.

In a study performed in 1976 pertaining to the classification of knee ligament instabilities, Hughston *et al*. [1, 2] divided the lateral compartment ligaments of the knee into three anatomic divisions.

The middle third composed of the iliotibial band and deep capsular ligaments. Within this middle division, the lateral capsular ligament attaches proximally to the lateral epicondyle of the femur and distally to the tibial joint margin, with attachments to the meniscus divided into meniscofemoral and meniscotibial portions. Those articles provided the blueprint for the detailed anatomy that comprises the lateral aspect of the knee used by many authors thereafter [1,2].

In a study of the iliopatellar band and iliotibial tract in 1986, Terry *et al*. [3] referred to the capsuloosseous layer of the iliotibial tract as the anterolateral ligament because of this structure's contribution to the lateral stability of the knee. The distal tibial insertion is described as being just posterior to the Gerdy's tubercle, on the lateral tibial tuberosity. It should be noted that in that study, there was a specific reference to an additional lateral structure referred to as the mid third capsular ligament. [3]

In 2012, in an anatomic and histologic study of those undergoing total knee arthroplasty and in cadaveric dissections, Vincent *et al*. [5] described a structure that links the lateral femoral condyle, lateral meniscus, and lateral tibial plateau and referred to it as the anterolateral ligament. This structure arose from the lateral femoral condyle in the majority of cases. In each case, the structure was closely related to the lateral meniscus and always inserted onto the proximal anterolateral tibia. Vincent *et al*. stated that this structure is synonymous with the one described by Terry *et al*. [3] and later Vieira *et al*. [4] (capsuloosseous layer of the iliotibial tract).

Claes and Bellemans (2013) found that the ALL originates at the lateral epicondyle of the femur, and inserts at the anterolateral aspect of the proximal tibia [7].

The gross anatomy of this ALL has been studied and documented, like in the case of Dr. Steven Claes in his recent publication on "Anatomy of the Anterolateral Ligament of the Knee" [7].

RESULTS

Out of the 25 patients with internal derangement of knee, the anterolateral ligament was analyzed in three segments (femoral attachment, meniscal attachment and tibial attachment) and the results were tabulated (Table 1).

Table 1 anterolateral ligament was analyzed for presence of injury in three segments (femoral attachment, meniscal attachment and tibial attachment) and the results were tabulated

Site of tear	Frequency	Percentages
Femoral attachment		
Torn	11	44.00%
Normal	13	52.00%
Not seen	1	4.00%
Meniscal attachment		
Normal	24	96.00%
Not seen	1	4.00%
Tibial attachment		
Avulsed	1	4.00%
Normal	24	96.00%

Out of 25 patients with internal derangements, 13 had an injury of the anterolateral ligament (Table 2). 2 patients had a thickened distorted ALL. 10 patients had a normal anterolateral ligament.

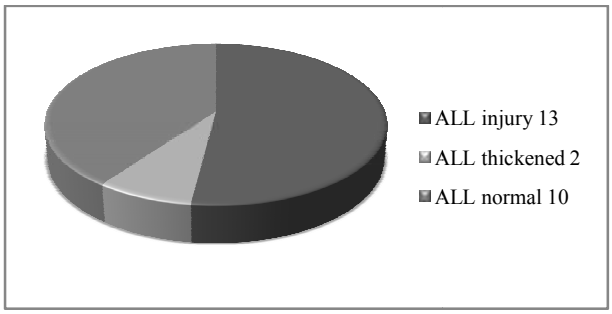

Table 2 the anterolateral ligament was injured in 13 out of 25 patients, thickened in 2 patients and normal in 10 patients

Out of the 25 patients with internal derangements, 15 had an ACL injury. Out of these 15 patients with ACL injury the ALL was injured in 11 patients (Tables 3 and 4)

Table 3 out of 15 patients with ACL injury the ALL was injured in 11

ALL femoral attachment tear	ACL – proximal and / or mid segment injury
11	11

Table 4 4 patients with ACL injury had a normal ALL

Anterolateral ligament normal	ACL injury
4	4

There was one internal derangement involving a bucket handle tear of the lateral meniscus which involved complete tear of the anterolateral ligament (Table 5).

Table 5 one patient had a bucket handle tear of lateral meniscus with associated complete tear of ALL

Bucket handle flipped tear – body of lateral meniscus	Anterolateral ligament not visualized in toto, likely complete tear
1	1

There was one internal derangement (out of 25) with a Segond's fracture which involved tibial avulsion of the anterolateral ligament.

DISCUSSION

This study is discussed in two parts.

Part 1 - Anterolateral ligament in patients with a normal MRI of the knee

We tried to identify and characterize a normal anterolateral ligament in 25 patients who were referred for an MRI of the knee for vague knee pain, with or without associated trauma, where there were no significant positive MRI findings.

In all these 25 patients we were able to identify a fibrous hypointense band like ligament in the previously described location [2, 3, 4, 6, 7, 8, 12, 11, 14] of the anterolateral ligament (Figure 1a, b, c, d). And its attachments were as follows:

Femoral attachment of the anterolateral ligament (figure 1a and 1b): this was seen to merge with the anterior aspect of the femoral attachment of the fibular collateral ligament in all cases. Separately delineating the femoral attachment of the anterolateral ligament from the fibular collateral ligament was not possible in any of our patients. It was therefore taken to be the anterior most extension of the fibular collateral ligament. This was seen to be deep to the adjacent iliotibial band.

Meniscal attachment of the anterolateral ligament (Table / Figure 1a and 1c): the meniscal component of this ligament was well identifiable in all patients. The superior aspect (meniscofemoral component) was the part extending from the femoral attachment to the body of the lateral meniscus; this segment was again seen deep to the iliotibial band. The inferior aspect (meniscotibial component) was the part extending from the meniscus to the tibia, and was well delineated in all patients. Both the meniscofemoral and mensicotibial components of the anterolateral ligament were best visualized in the thin coronal proton density sequences.

Tibial attachment of the anterolateral ligament (Figure 1a and 1d): the tibial insertion of this ligament was seen to be closely abutting the posterior aspect of the tibial insertion of the iliotibial band at the Gerdy's tubercle. The tibial attachment of the anterolateral ligament was visualized and evaluable in all 25 of our patients.

Figure 1a Coronal PD FS image showing the normal anterolateral ligament and its three attachments (orange arrows)

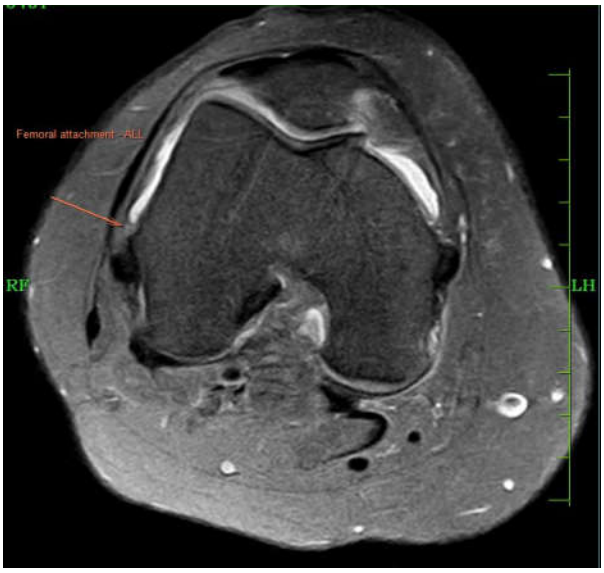

Figure 1b Axial PD FS showing the femoral attachment of ALL (orange arrow)

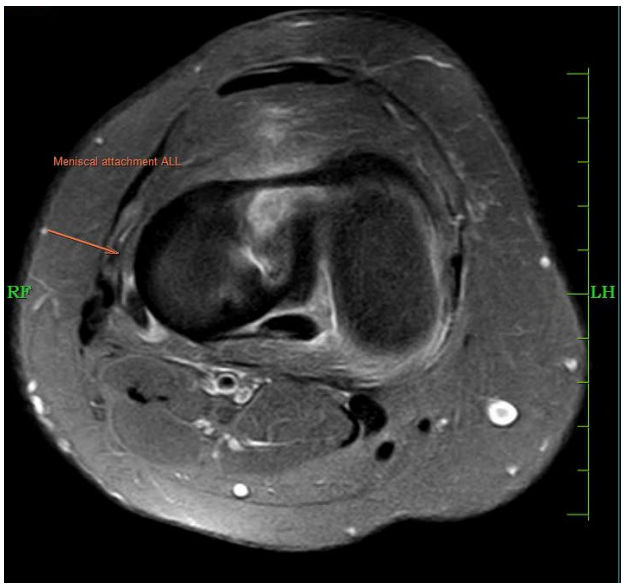

Figure 1c Axial PD FS showing the meniscal attachment of ALL (orange arrow)

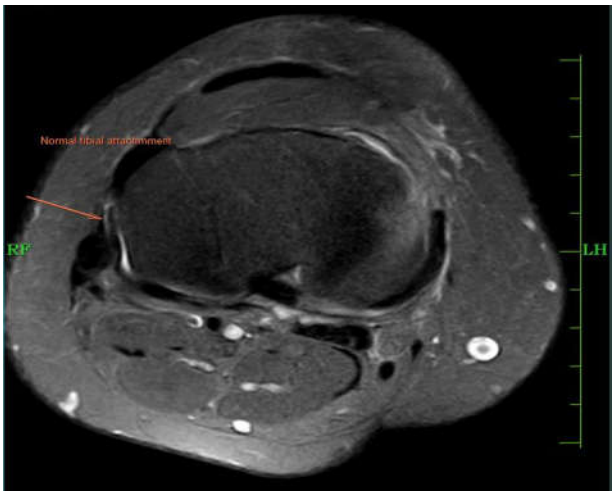

Table / Figure 1d Axial PD FS showing the tibial attachment of the ALL (orange arrow)

Part 2 - Anterolateral ligament in patients with internal derangement findings in MRI of the knee

When we analyzed the results obtained for MRI knee of 25 patients who had an MRI diagnosis of some form of internal derangement of knee (inclusive of cruciate ligament, meniscal and collateral ligament injuries), we found the anterolateral ligament was intact in 10 patients. The interesting fact was the anterior cruciate ligament was also intact in all 6 of these patients. 4 patients with intact ALL had an anterior cruciate ligament injury which included strain, partial tear and one patient with complete tear.

We identified in MRI a strain / partial tear / complete tear of the femoral attachment of the anterolateral ligament in 11 of these 25 patients (Figure 2a, 2b and 2c). Again this directly correlated with an anterior cruciate ligament injury. These 11 patients had some form of anterior cruciate ligament injury; ranging from strain to complete tear of the proximal and / or mid anterior cruciate ligament [9, 13]. Some of these patients had an associated meniscal injury. None of these 11 patients had a distal anterior cruciate ligament tear.

Figure 2a coronal PD FS showing a tear of the ALL at its femoral attachment (orange arrow)

Figure 2b Sagittal PD FS showing associated ACL tear at femoral attachment (orange arrow)

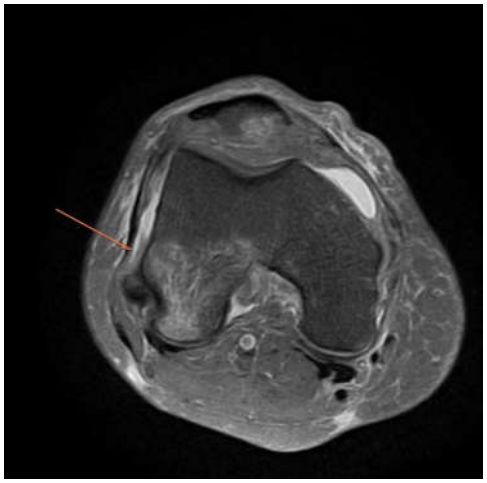

Figure 2c PD FS axial showing edema and tear of ALL at femoral attachment (orange arrow)

We had one patient with a bucket handle tear of the body of lateral meniscus where there was complete non visualization of the anterolateral ligament (Figure 3a and 3b). This possibly involved the meniscal attachments of the anterolateral ligament; when the body of lateral meniscus flipped medially, the sudden severe pull on the meniscal attachments of the Anterolateral ligament possibly resulted in avulsion of the ligament in its entirety.

Figure 3a Coronal PD FS showing a completely absent ALL (purple arrow), with fluid filling the gap

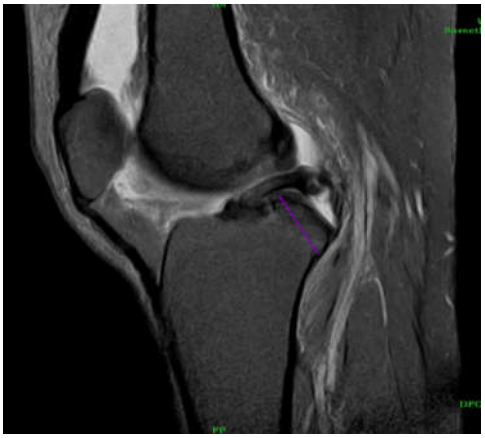

Figure 3b Sagittal PD FS image in the same patient showing a flipped lateral meniscal fragment in the intercondylar notch (purple arrow)

We had one patient with a Segond's fracture and avulsion of the tibial insertion of the anterolateral ligament (Table / Figure 4a and 4b). In this patient, the finding seemed to prove that Segond's fracture almost exactly involves the tibial insertion of the anterolateral ligament. We inferred that the previously described association of Segond's fracture with anterior cruciate ligament tears [10, 15] was actually an association of Segond's fracture with anterolateral ligament injury, which in turn is often associated with an anterior cruciate ligament injury. This is further established by the fact that this particular patient had a partial avulsion of the tibial insertion of the anterior cruciate ligament as well.

Figure 4a Coronal PD FS showing a Segond's fracture with avulsion of the tibial attachment of ALL (red arrow), and diffuse edema in the ALL. Tibial marrow edema seen at the site of fracture

Figure 4b Coronal CT reformatted image in the same patient showing the fractured fragment (red arrow)

Two of our patients had a distorted and thickened anterolateral ligament (Figure 5); these patients also had a strain of the lateral collateral ligament complex. Possibly the chronic strain on the anterolateral ligament had resulted in thickening and fibrosis of the same.

Two of our patients had a distorted and thickened anterolateral ligament (Figure 5); these patients also had a strain of the lateral collateral ligament complex. Possibly the chronic strain on the anterolateral ligament had resulted in thickening and fibrosis of the same.

Figure 5 Coronal PD FS showing a thickened and distorted ALL (red arrows)

CONCLUSION

With this study, we were able to more assertively establish the anatomy and attachments of the relatively unexplored anterolateral ligament, and were able to assess in detail the three segments of this ligament.

The anterolateral ligament injuries were found to have a strong association with tears of the anterior cruciate ligament, flipped tears of the body of lateral meniscus as well as Segond's fracture. We also inferred from this study that the other internal derangements of the knee had no definite direct association with anterolateral ligament.

Summing up, the anterolateral ligament needs to be looked for and assessed in every suspected internal derangements involving the anterior cruciate ligament, body of lateral meniscus and Segond's fracture. Neglecting to assess this ligament could result in inadequate management.

Bibliography

1. Manaster BJ. Knee section VI. In: Manaster BJ, Roberts RC, Andrews CL, *et al*., eds. Diagnostic and surgical imaging anatomy musculoskeletal. Salt Lake City, UT: Amirsys, 2006:20-33
2. Netter FH. Atlas of human anatomy, 5th ed. Philadelphia, PA: Saunders, 2011:472-476.
3. Claes S, Vereecke E, Maes M, Victor J, Verdonk P, Bellemans J. Anatomy of the anterolateral ligament of the knee. *J Anat* 2013; 223:321-328
4. Vincent JP, Magnussen RA, Gezmez F, *et al*. The anterolateral ligament of the human knee: an anatomic and histologic study. Knee Surg Sports *Traumatol Arthrosc*. 2012;20:147-52.
5. Vieira EL, Vieira EA, da Silva RT, Berlfein PA, Abdalla RJ, Cohen M. An anatomic study of the iliotibial tract. *Arthroscopy*. 2007;23: 269-74.
6. Helito CP, Miyahara HS, Bonadio MB, *et al*. Anatomical study of the anterolateral ligament of the knee. *Rev Bras Ortop*. 2013;48:368-73.
7. Claes S, Vereecke E, Maes M, Victor J, Verdonk P, Bellemans J. Anatomy of the anterolateral ligament of the knee. *J Anat*. 2013;223: 321-8.
8. Helito CP, Demange MK, Bonadio MB, *et al*. Anatomy and histology of the knee anterolateral ligament. *Orthop J Sports Med.* 2013;1: 2325967113513546.
9. Monaco E, Ferretti A, Labianca L, *et al*. Navigated knee kinematics after cutting of the ACL and its secondary restraint. *Knee Surg Sports Traumatol Arthrosc.* 2012;20:870-7.
10. Weber MA. New aspects on the macroanatomy of anterolateral ligament structures of the knee and the implications for Segond fractures. *Radiologe*. 2013;53:1072-4.
11. Claes SA, Vereecke, Evie M, *et al*. The anterolateral ligament of the knee: anatomy, radiology, biomechanics and clinical implication. Poster session presented at AAOS Annual Meeting; 2013 Mar 19-23; Chicago, IL.
12. Gossner J. The anterolateral ligament of the knee: visibility on magnetic resonance imaging. *Rev Bras Ortop*. 2014;49:98-9.
13. Ayeni OR, Chahal M, Tran MN, Sprague S. Pivot shift as an outcome measure for ACL reconstruction: a systematic review. Knee Surg Sports Traumatol *Arthrosc*. 2012;20:767-7.
14. Watanabe AT, Carter BC, Teitelbaum GP, Seeger LL, Bradley Jr WG. Normal variations in MR imaging of the knee: appearance and frequency. *AJR Am J Roentgenol*. 1989;153:341-4.
15. Campos JC, Chung CB, Lektrakul N, *et al*. Pathogenesis of the Segond fracture: anatomic and MR imaging evidence of an iliotibial tract or anterior oblique band avulsion. *Radiology*. 2001;219:381-6.

How to cite this article:

Anita Soundarapandian *et al.*2017, MRI Study of The "Anterolateral Ligament of The Knee": Appearance, tears And its Association With Other Internal Derangements of The Knee. *Int J Recent Sci Res.* 8(12), pp. 22824-22829. DOI: http://dx.doi.org/10.24327/ijrsr.2017.0812.1343

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