

## CASE REPORT

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# Release of retromalleolar flexor retinaculum and combined flexor digitorum longus and flexor hallucis longus Z-plasty in checkrein deformity: a case report

Komang Agung Irianto<sup>1,2</sup>, Henry Ricardo Handoyo<sup>2,3</sup>, and Enrico Leonarto<sup>2,4</sup>

## ABSTRACT

## BACKGROUND

Checkrein deformity is a rare abnormality comprising flexor hallucis longus (FHL) tendon entrapment in the posterior foot due to post-traumatic or ischemic retraction of the FHL tendon following soft tissue trauma. The diagnosis is essentially clinical, but complemented by imaging to rule out unrecognized causes and evaluate the fracture healing process. This case report is the first Indonesian study to describe release of the flexor retinaculum and Z-plasty (lengthening) of flexor digitorum longus (FDL) and FHL tendons through a medial retromalleolar approach to repair the deformity.

## CASE DESCRIPTION

We present the case of a 51-year-old male who complained of clawing of his right first and second toes. The interest of this study lies in the fact that this patient had never experienced ankle or distal tibial fractures, only a trivial injury two years back when the patient kicked a stone at work and had a bruise on his right second toe with no fracture. Exploration of FHL tendons was performed at the level of the midfoot. The patient was planned for surgery with a medial retromalleolar ankle approach, which facilitates the release of the flexor retinaculum, in conjunction with a Z-tenotomy on the FHL and FDL tendons.

## CONCLUSION

A correction was achieved, and two months post-surgery there were no recurrences of the deformity. However, this surgical procedure requires more cases to support an evaluation of its effectiveness. We suggest that exploration at the ankle and midfoot should be the primary surgical intervention in similar cases of checkrein deformity.

**Keywords:** Checkrein deformity, flexor retinaculum, Z-plasty, FDL, FHL, medial retromalleolar

<sup>1</sup>Department of Orthopaedic and Traumatology, Faculty of Medicine, Universitas Airlangga/Dr. Soetomo General Academic Hospital, Surabaya, Indonesia

<sup>2</sup>Surabaya Orthopaedic and Traumatology Hospital, Surabaya, Indonesia <sup>3</sup>Faculty of Medicine, Widya Mandala Catholic University, Surabaya, Indonesia

<sup>4</sup>Faculty of Medicine, Universitas Hasanuddin, Makassar, Indonesia

**\*Correspondence :**

Komang Agung Irianto  
Department of Orthopaedic and Traumatology, Faculty of Medicine, Universitas Airlangga/Dr. Soetomo General Academic Hospital, Surabaya, Indonesia  
Jl. Mayjend Prof. Dr. Moestopo 6-8, Surabaya 60286, Indonesia  
Fax: +6231-5030406  
Email: komang168@yahoo.com  
ORCID ID: 0000-0001-6625-970X

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## INTRODUCTION

Checkrein deformity is a rare abnormality in which the flexor hallucis longus (FHL) tendon is entrapped in the posterior foot.<sup>(1,2)</sup> Furthermore, there is also an extremely rare case of checkrein deformity caused by extensor hallucis longus (EHL) hypotrophy.<sup>(3)</sup> A great toe flexion deformity is the most common symptom. However, checkrein deformity can also affect the second and third toes. The deformity is more noticeable on dorsiflexion, but fades or disappears on plantar flexion.<sup>(4)</sup>

The deformity mainly occurs after ankle, distal tibial, and fibular fractures. However, talar and calcaneus fractures have also been involved.<sup>(5-8)</sup> It can also occur from contracture of the muscles after a subclinical compartment syndrome.<sup>(9)</sup> This study's interest lies in the fact that this patient has never experienced ankle or distal tibial fractures but only a slight ankle sprain two years back with no fracture. In this patient the deformity may have been caused by a tendon injury that was scarred after a local hematoma. Different surgical procedures have been proposed, i.e. midfoot Z-plasty tendon lengthening without release and retro-malleolar FHL tendon Z-plasty (at the tarsal tunnel).<sup>(4,10)</sup> In all these cases, surgery is followed by physical rehabilitation to recover and maintain the range of motion of ankle and toe joints. Furthermore, the most popular surgical procedures for this deformity are release of the adhesions followed by Z-plasty (lengthening) of the FHL tendon at the fracture site and Z-plasty (lengthening) of the FHL tendon at midfoot without release of the adhesions.<sup>(1)</sup> On the other hand, there are some drawbacks to lengthening of the FHL at the midfoot at the Henry knot. Loss of function in the lesser toes could be caused by the damaged major attachment of the FHL to the flexor digitorum longus (FDL) and flexor digitorum accessorius, which is known as the knot of Henry. The intimate relationship between the Henry knot and the plantar neurovascular branches also

makes the foot undergoing this method equally prone to neurovascular damage.<sup>(11)</sup>

However, in this patient, release of the flexor retinaculum and a Z-plasty (lengthening) of FDL and FHL were performed through the medial retromalleolar approach. The procedures were performed upon finding a swelling on the medial retromalleolar side of the right ankle during the physical examination. Furthermore, an ultrasound examination revealed tenosynovitis in the medial retromalleolar region of the right ankle, upon which a tenosynovectomy was conducted. This report describes the case of a patient who developed a checkrein deformity of the right foot following direct soft tissue trauma to his right leg, without associated fracture. Treatment consisted of release of the flexor retinaculum and Z-plasty of the flexor hallucis longus and flexor digitorum longus, achieving a satisfactory outcome.

## CASE REPORT

Clawing of the right great toe and second toe was reported by a 51-year-old male patient. The patient's great toe and second toe were injured eight years ago when he kicked a stone at his workplace. The patient noticed clawing of his right great toe and second toe four years after the incident when walking barefoot. He also expressed dissatisfaction with his difficulty with sports and particular ankle movements.

Another physical examination revealed swelling and pain on the medial side of the right ankle. Active dorsiflexion of the ankle joint caused excessive flexion of the great and second toes. The patient could not fully extend the great and second toes either actively or passively with the ankle in dorsiflexion. Tenosynovitis was discovered on ultrasonography of the medial right ankle. As a result, the patient was diagnosed with checkrein deformity of his right great toe and second toe, which was related to a previous injury that caused scarring and tenosynovitis in the flexor tendons of the great toe and second toe, especially on the posteromedial side of the ankle.



**Figure 1.** Intraoperative exposure of flexor retinaculum flexor digitorum longus (FDL) (release)



**Figure 2.** Intraoperative view of exposed cut flexor digitorum longus (FDL) and explored flexor hallucis longus (FHL)

The patient's right sandal often had a depression or crack because of over-pressure by his right toes. During the operation, we performed exploration and retinaculum release on the posteromedial side of the right ankle, followed by Z-plasty of FDL and FHL tendons (Figure 1-3). Three months post-operation, the patient was satisfied with the result because he experienced good correction of right great and second toes with only minimal contracture (Figure 4).

A medial retromalleolar ankle approach was scheduled for the patient. This method involves facilitating the release of the flexor retinaculum before performing a Z-tenotomy on the FHL and FDL tendons, both of which can be accessed through ankle exploration, after the FDL tendon is identified. The FDL- and FHL-plasty resulted in a complete release of the toe flexion contracture. The patient was immobilized with a splint for three weeks after surgery, with the ankle in the neutral position. Three months post-surgery, the patient made a good post-operative recovery and almost full range of motion in all toes was achieved with minimal flexion contracture. A post-operative follow-up also discovered active flexion and extension of the great and lesser toe while the ankle was in neutral dorsiflexion. Informed consent was obtained from the patient, and this study was conducted in accordance with the Declaration of Helsinki.



**Figure 3.** Intraoperative view of post-Z-plasty of flexor flexor hallucis longus (FHL) and flexor digitorum longus (FDL) tendons



Figure 4. Three months post-surgery, patient shows good correction of right first and second toes with minimal contracture and good functional result

## DISCUSSION

The interest of this study lies in the fact that this patient had never experienced ankle or distal tibial fractures, only a trivial injury eight years back when he kicked a stone at work and had a bruise on his right second toe with no fracture. The patient was planned for surgery with a medial retromalleolar ankle approach, which facilitates the release of the flexor retinaculum, followed by a Z-tenotomy on the FHL and FDL tendons. The correction was achieved, and two months post-surgery the deformity has shown no recurrences. Many studies and publications have suggested that the origin of this deformity is primarily attributable to a subclinical compartment syndrome. Checkrein deformity can occur after trauma because of FHL entrapment within fracture fragments.<sup>(12)</sup> Checkrein deformity is often found in patients with hallux deformity following a free fibular graft used to fill the mandibular bone defect resulting from oral cancer treatment<sup>(13)</sup> In extremely rare cases, checkrein deformity can also be caused by EHL hypotrophy<sup>(3)</sup> due to an increase in intra-compartmental pressure caused by subclinical compartment syndrome. The deformity may also be caused by EHL hypotrophy due to an anterior compartment syndrome after tibial fracture, vascular malformation, or by EHL contracture following triplane fracture,<sup>(3)</sup> progressing into an

injury of the musculotendinous junction of the FHL, resulting in mild tendon hypotrophy.

As a rule, checkrein deformity can take months to years to manifest after the original trauma, as in this case report. The shortest reported interval is 2 months.<sup>(14)</sup> There are various surgical options for correcting the deformity, such as extending the FHL tendon at midfoot on the site of the Henry knot.<sup>(1,11)</sup> The cause in the present case was a trivial injury, namely a contusion, which resulted in progressive plantarflexion (clawing) of the right great toe and second toe, and progressed into scarring followed by fibrosis and adhesion, thus presumably further leading to a loss of tendon elasticity requiring surgical intervention.

The surgical method necessary to fix checkrein deformity is specific because of the anatomical position of the FHL tendon, which originates from the interosseous membrane and the lower two-thirds of the posterior portion of the fibula. Yuen and Liu<sup>(2)</sup> reported two types of surgical methods. The first procedure involves reducing the adhesions and stretching the tendon with Z-plasty. This procedure is performed at the fracture site at the musculotendinous junction, which is located above the ankle. The second procedure involves FHL tendon lengthening at the midfoot. The FHL tendon lengthening procedure at the retromalleolar region involves the musculotendinous intersection of the FHL ligament, which position could lead to adhesion and recurrence. Z-plasty of the FHL tendon at the tarsal tunnel may result in more vigorous walking compared to the tenotomy procedure of the FHL tendon. This is due to the Z-plasty procedure linking the ligament rather than tearing the FHL tendon.<sup>(15)</sup> Another case report by Rodriguez-Collell and Mifsut-Miedes<sup>(4)</sup> stated that Z tenotomy of the FHL tendon resulted in full recovery of the checkrein deformity with full restoration of active flexion/extension of the great and lesser toes when the ankle is in neutral dorsiflexion. However, a case report by Feng et al.<sup>(5)</sup> presented an improvement in a 28-year-old female patient who had checkrein deformity after



comprehensive rehabilitation therapy for 20 days, but further research is still needed.

To the best of our knowledge, this case report is a one-of-a-kind study that describes releasing the flexor retinaculum through a medial retromalleolar approach. We chose this method over midfoot Z-plasty lengthening because of the discovery of swelling on the medial retromalleolar side of the right ankle. A further ultrasound examination revealed tenosynovitis on the medial retromalleolar right ankle, which required a tenosynovectomy.

Post-surgery, no clawing toes were found with the ankle in a plantigrade position. A similar result was recorded by Rodriguez-Collell and Mifsut-Miedes,<sup>(4)</sup> who reported on FHL tendon Z-plasty that was performed between the flexor retinaculum and the adhesion site of the right great toe. Their result showed no clawing toe deformity with the foot in the plantigrade position. Treatment by arthroscopic tenotomy of the flexor hallucis longus was described by Mudarra et al.,<sup>(16)</sup> who recommended it for treatment of checkrein deformity due to its technical simplicity, low iatrogenicity, early recovery, and theoretical absence of recurrence. However, the optimal site (midfoot or retromalleolar region) at which to perform the procedure for claw deformity correction is still unclear. In our case, the issue was resolved through the medial retromalleolar procedure because tenosynovitis was found at the synostosis site (near the retromalleolar groove). We believe that releasing the flexor retinaculum followed by FHL and FDL tendon lengthening (Z-plasty) could become an option to achieve deformity correction.

## CONCLUSION

Release of the retromalleolar flexor retinaculum and lengthening of the flexor hallucis longus (FHL) and flexor digitorum longus (FDL) tendons at the retromalleolar site, as was performed in the present case, may be a feasible option to repair checkrein deformity. In our case, the correction was achieved with no sign of

recurrence. Nevertheless, more cases are needed to confirm the efficacy of this surgical procedure in ensuring a better outcome without recurrence and complications.

## CONFLICT OF INTERESTS

The authors declared no conflicts of interest.

## AUTHOR CONTRIBUTIONS

KAI is the senior orthopaedic surgeon (operator) who diagnosed the case and was responsible for the management of the patient. HRH is a junior orthopaedic surgeon (foot and ankle surgeon) assisting in the operation, collecting literature, writing, editing, and supervising the case report. EL contributed to writing the manuscript draft. All authors have read and approved the final manuscript.

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## Data availability statement

Not applicable.



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