JIMA Vol. 71, No. 4 (Oct 2019) pp. 115-125.

Original

An anatomical study of flexor pollicis longus blood supply in the distal radius and locking screw locations of volar locking plates: a cadaver study

Yuki Kikuchi [1)], Kotaro Sato [1)], Goro Tajima [1)], Jun Yan [2)], Kenya Murakami [2)], Yoshikuni Mimata [1)] and Minoru Doita [1)]

[1)] Department of Orthopedic Surgery, School of Medicine, Iwate Medical University, Morioka, Japan

[2)] Department of Anatomy, School of Medicine, Iwate Medical University, Yahaba, Japan

(Received on January 22, 2019 & Accepted on February 14, 2019)

Abstract

Flexor pollicis longus (FPL) tendon injuries after volar locking plate (VLP) surgery have been reported in patients with distal radius fractures (DRFs). Irritation due to plate prominence or tendon degradation due to deteriorating blood flow is an important factor in FPL tendon ruptures. The purpose of this study was to identify the vessels feeding the FPL and to investigate the articular support of various volar locking plates attached as distally as possible in cadaver wrists. The study involved the dissection of 14 upper limb specimens (8 men and 6 women). The dissections identified the FPL and its related feeding arteries, which were the radial artery (RA) and anterior interosseous artery (AIA). We measured the length of each. Thereafter, we attached each plate in six different cadavers. We attempted to position each plate as distally as possible without FPL tendon contact. We obtained lateral radiographs and analyzed the drill locations. The distances between the drill and the articular surface were over 3 mm in most measurements for the 4 fixed locking plates and that for the 2 variable-angle locking plates were more than 4.9 mm. All plates showed low subchondral support when attempting to avoid FPL tendon contact. The most distal branch of the RA is frequently injured during VLP surgery because of its proximity to the surgical field. Careful preservation of the most distal branch of the AIA is recommended for preventing deterioration of blood flow to the FPL and development of hematomas.

Key words : *volar locking plates, flexor pollicis longus, feeding vessels, radial artery, anterior interosseous artery*

I. Introduction

The volar locking plate (VLP) has been widely used in patients with unstable distal radius fractures, and many clinical studies have warned about implant-related flexor pollicis longus (FPL) rupture[1-5]. Previous studies have shown that irritation of the implant prominence is a risk factor for tendon rupture[4,5]. Biomechanical studies on screw locations for VLPs suggested placement of screws as subchondral as possible to avoid

Corresponding author: Yuki Kikuchi
kikuchi0122@gmail.com

loss of reduction [6,7]. To date, biomechanical studies have not considered tendon rupture associated with the distal setting of the VLP [7-11]. Surgeons should place the plate distally; however, there should be no FPL tendon contact.

In the last decade, studies have reported on modified plate designs, and the screws may provide good subchondral support [8, 12-14]. However, the most appropriate attachment of the plate varies, and the contour of the volar distal radius shows individual differences.

On the other hand, normal blood circulation is an important factor for keeping tendons healthy. The durability of tendons depends on several factors such as blood supply, presence of rheumatoid arthritis[15], and steroid use[16]. However, there are only a few reports on the role of feeding vessels in flexor pollicis longus (FPL) tendons. FPL tendons have three circulation systems. First, the vinculum system provides blood supply at the digital area. Second, the synovium system via the median nerve artery provides blood supply at the level of the distal radius. Lastly, the circulation from the FPL muscle in the forearm also supplies blood to the FPL tendon [19-23].

The VLP surgical approach involves an incision in the flexor carpi radialis (FCR) tendon. After dividing the FCR tendon and the radial artery (RA), the FPL is retracted at the ulnar side and then the volar surface of the radius is exposed. Most surgeons detach the pronator quadratus (PQ) from the radial border to place the volar plate on the fracture site.

Blood flow to the FPL tendon can be decreased due to scar formation and damage to the feeding vessels and the synovium after VPL surgery. We focused on the blood supply to the FPL and investigated the FPL feeding vessels. In addition, we conducted an anatomical study to investigate the distal limit of the safe position of commercially available VLPs. We aimed to investigate the screw locations with various VLPs attached as distally as possible without FPL tendon contact in cadaver wrists. We hypothesized that a VLP placed such that it does not touch the FPL tendon can sufficiently support the subchondral bone.

II. Materials and Methods

A total of 14 unpaired human cadaveric right upper limbs (8 male and 6 female specimens; age range, 65 to 99 years), with no severe macroscopic degenerative or traumatic changes, were used in this study.

All specimens were fixed with 10% formalin and were preserved in 50% alcohol for 6 months. The cadavers were donated to our institute for education and research purposes, and this study was approved by the ethics committee of Iwate Medical University (No. H28-90).

Cadaver preparation began by removing the skin and subcutaneous soft tissue on the forearm to expose the flexor muscle group. The FPL and flexor digitorum superficialis

---

Abbreviations: distal radius fractures (DRFs), volar locking plates (VLPs), flexor pollicis longus (FPL), flexor carpi radialis (FCR), radial artery (RA), pronator quadratus (PQ), flexor digitorum superficialis (FDS), flexor digitorum profundus (FDP II), anterior interosseous artery (AIA)

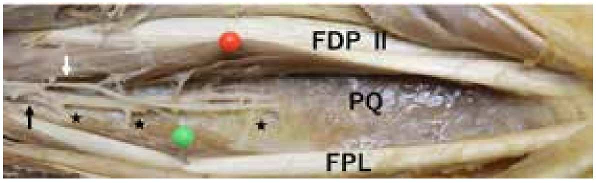

Fig. 1. Frontal view of the right forearm, showing the anterior interosseous artery. Black stars indicate branches from the anterior interosseous artery.
The white arrow indicates the anterior interosseous nerve. The black arrow indicates the anterior interosseous artery.
FDP II, flexor digitorum profundus II; PQ, pronator quadratus; FPL, flexor pollicis longus.

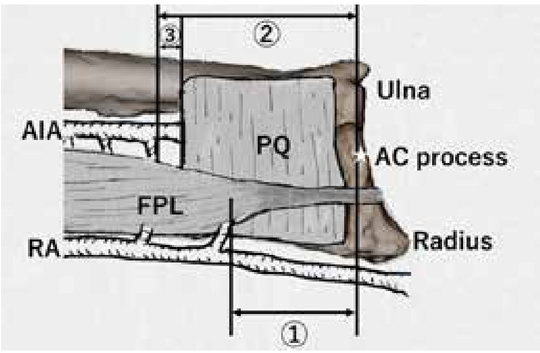

Fig. 3. Schematic diagram depicting each distance.
The red star indicates the AC process.
AIA, anterior interosseous artery; RA, radial artery.

Fig. 5. Plate placement
a. Plate placement view from the front. We removed the flexors, except for the flexor pollicis longus (FPL).
b. Plate placement view from the lateral side. We fixed the plate to the cadaver as distally as possible without FPL contact.

Fig. 2. Frontal view of the right forearm, showing the radial artery.
Black stars indicate branches from the radial artery.
FDP II, flexor digitorum profundus II; PQ, pronator quadratus; RA, radial artery.

Fig. 4. The six plates used in this study.
A, VariAx; B, VA-TCP; C, HYBRIX; D, MODE; E, Acu-Loc2P; F, DVR.

Fig. 6. Holes A and B
Hole A is the most ulnar hole of the distal row, and hole B is the second ulnar hole of the distal row.

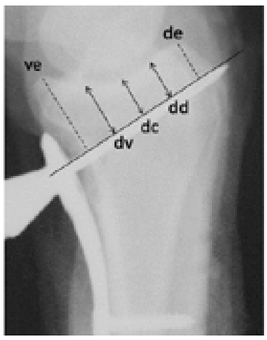

Fig. 7. A line is drawn perpendicular to the drill from the articular surface to the drill. We measured the distances between the drill and the center, dorsal halfway point, and volar halfway point as the dc, dd, and dv values, respectively.
de, dorsal edge; ve, volar edge.

(FDS) were exposed when the FCR was removed. The FDS arose from the radial border and a part of its origin was attached to the FPL. After removal of the FDS, the FPL originated from the radial border of the radius to the interosseous membrane, joining the flexor digitorum profundus (FDP II) in the middle of the forearm (Fig. 1). Between the FDP II and FPL, the anterior interosseous artery (AIA) ran on the interosseuous membrane, accompanied by the anterior interosseous nerve (Fig. 1). The AIA ran with branches supplying the FPL and went into the PQ from the proximal edge (Fig. 1). In the middle of the forearm, the RA ran along the ulnar side of the brachioradialis muscle. The RA descended on the radial side of FPL and extended to the wrist, also supplying the FPL (Fig. 2). The FPL muscle was supplied by branches from the AIA on the ulnar side and from the RA on the radial side.

The number of branches was recorded. The most volarly prominence on the distal radius (AC process); the proximal edge of the PQ; the most distal branch of the AIA; and the most distal branch of the RA were marked and each of their distance was measured. (Fig. 3) Thereafter, we investigated the screw locations with various VLPs attached as distally as possible without FPL tendon contact for 6 cadavers. Six widely used VLPs with current designs (two variable-angle locking plates and four fixed locking plates) were investigated. The variable-angle locking plates were VariAx (Stryker, Kalamazoo, MI, USA, launched in 2010) and Variable-angle LCP two-column volar distal radius plate 2.4 (VA-TCP; Depuy Synthes, West Chester, PA, USA, launched in 2009), while the fixed locking plates were HYBRIX (Mizuho, Tokyo, Japan, launched in 2015), MODE (JAPAN MEDICAL DINAMIC MARKETING INC, MDM, Tokyo, Japan, launched in 2012), Acu-Loc2P (Acumed, Hillsboro, OR, USA, launched in 2011), and DVR (Zimmer Biomet, Warsaw, IN, USA, launched in 2000) (Fig. 4). Each plate was placed in six different cadavers; thus, there were 36 different plate-cadaver combinations. We used the smallest size of each plate because such a size is common in clinical practice and is appropriate for most Japanese specimens. We attempted to position the plate as distally as possible without FPL tendon contact and with the best fit in the radial-ulnar position (Fig. 5a, b). One hand surgeon performed all plate placements under direct visualization. First, the plates were fixed roughly with a cortical screw in the oblique hole. Next, plates were adjusted proximally or distally without touching the FPL tendon during 30° wrist extension [25]. Finally, the plates were fixed with a locking screw. Thereafter, another orthopedic surgeon confirmed that the plates were not in contact with the FPL tendon. To minimize bias associated with the order of fixation, we fixed each plate to the first cadaver in regular order and then to the second cadaver in reverse order. We used the same approach from the third to sixth cadavers. We fixed the plate to the radial cortex thorough the same cortical screw hole, while fixation was maintained. When the plate could not obtain rigid fixation because of screw loosening, we drilled another hole and achieved secure fixation. A lateral radiograph was obtained using fluoroscopy by confirming projection of the pisiform over the distal portion of the scaphoid, according

Table 1. Anatomical findings

Case	Age	Sex	Number of branches		Distance from AC process to the most distal branch (mm)		The distance between the proximal edge of the PQ and the most distal branch of the AIA (mm)
			RA	AIA	RA	AIA	
1	89	M	1	2	35	50	15
2	75	F	1	3	85	55	10
3	67	M	3	5	35	55	10
4	72	F	2	4	58	60	20
5	84	M	3	5	40	52	12
6	79	M	1	3	63	71	20
7	83	F	1	2	54	52	15
8	85	M	2	5	48	52	5
9	74	F	2	4	24	38	4
10	64	M	2	7	24	66	22
11	89	M	0	5	0	58	5
12	80	F	3	4	24	72	25
13	70	M	4	4	35	68	26
14	86	F	1	3	35	49	10
mean	78		2	4	43	57	14

to the methods of Soong et al [4]. Analyses involved the most ulnar hole and the second ulnar hole of the distal row because these screw holes were used to fix the volar lunate facet, which is the most important to support longitudinal load. The most ulnar hole of the distal row was considered hole A, and the second ulnar hole was considered hole B (Fig. 6). Hole B was the center hole of the distal row for VariAx, HYBRIX, MODE, and DVR. We performed drilling under fluoroscopic guidance and obtained lateral radiographs. We performed all drilling procedures in a fixed manner using the specific jig of each plate (both fixed locking and variable-angle locking plates). As we could insert the drill more accurately and avoid misdirection when compared with screw insertion using a screwdriver, we investigated radiographs of the drill rather than those of the screw.

Measurements

In lateral radiographs, we marked the center of the articular surface, dorsal halfway point between the center and dorsal edge, and volar halfway point between the center and volar edge. Thereafter, we drew a line perpendicular to the drill at each point. We then measured the distances between the drill and the center, dorsal halfway point, and volar halfway point as the dc, dd, and dv values, respectively (Fig. 7). All measurements were adjusted using the radiolucent scale in the radiographs. The first author measured radiographic parameters using a DICOM viewer (Yakami DICOM Tools, Kyoto University, Kyoto, Japan). The mean value of two measurements was used as the final value. When the measured value between two measurements differed by more than 1.5 mm, the images were re-measured, and a final value was determined by consensus.

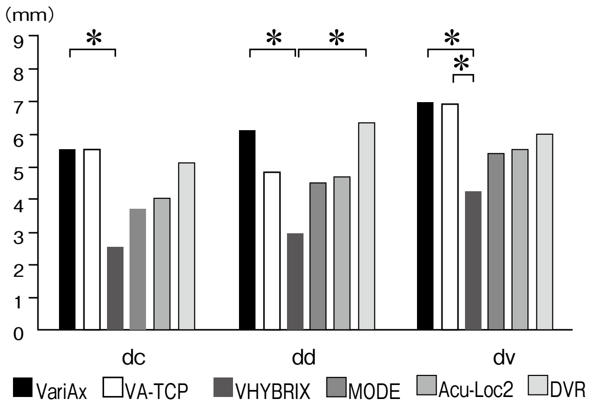

Fig. 8. Results for hole A
The dc, dd, and dvvalues indicate the distances between the drill and the center, dorsal halfway point, and volar halfway point, respectively. * p < 0.05

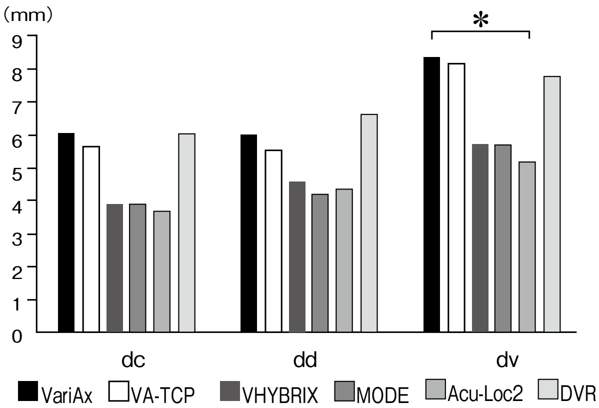

Fig. 9. Results for hole B.
The dc, dd, and dv values indicate the distances between the drill and the center, dorsal halfway point, and volar halfway point, respectively. * p < 0.05

Statistical analysis included one-way analysis of variance with the Tukey test; $p < 0.05$ was considered statistically significant.

III. Results

1. Blood supply to the FPL

Blood supply to the FPL was from the branches of the AIA and RA (Fig. 3) (Table 1). The mean number of branches of the RA and AIA was 2.0 (0-4) and 4.0 (2-7), respectively (Fig. 3) (Table 1).

The mean distance from AC process to the most distal branch of the RA and AIA was 43.0 (24 to 85) and 57.0 (38 to 72) mm, respectively (Fig. 3) (Table 1).

The mean distance between the proximal edge of the PQ and the most distal branch of the AIA was 14.2 mm (4 to 26 mm) (Fig. 3) (Table 1).

2. Measurement

Hole A

The mean dc values for VariAx, VA-TCP, HYBRIX, MODE, Acu-Loc2P, and DVR were 5.6 ± 1.06mm, 4.9 ± 0.68 mm, 2.6 ± 1.34 mm, 3.8 ± 1.85mm, 4.1 ± 1.37 mm, and 5.2 ± 1.51 mm, respectively (Fig. 8). The mean dd values for VariAx, VA-TCP, HYBRIX, MODE, Acu-Loc2P, and DVR were 6.2 ± 1.32 mm, 4.9 ± 1.19 mm, 3.0 ± 1.33 mm, 4.6 ± 1.77 mm, 4.8 ± 1.33 mm, and 6.4 ± 1.70 mm, respectively. The mean dv values for VariAx, VA-TCP, HYBRIX, MODE, Acu-Loc2P, and DVR were 7.1 ± 0.74 mm, 7.0 ± 0.83 mm, 4.3 ± 1.60 mm, 5.5 ± 1.89 mm, 5.6 ± 1.27 mm, and 6.1 ± 1.59 mm, respectively.

The dc value for HYBRIX was significantly smaller than that for VariAx ($p < 0.05$). The dd values for HYBRIX were significantly smaller than that for VariAx ($p < 0.05$) and DVR ($p < 0.05$). The dv values for HYBRIX were significantly smaller than those for VariAx ($p < 0.05$) and VA-TCP ($p < 0.05$).

Hole B

The mean dc values for VariAx, VA-TCP, HYBRIX, MODE, Acu-Loc2P, and DVR were 5.9 ± 1.09 mm, 5.5 ± 0.68 mm, 3.8 ± 1.53 mm, 3.8 ± 1.84 mm, 3.6 ± 1.39 mm, and 5.9 ± 2.19 mm, respectively (Fig. 9). The mean dd values for VariAx, VA-TCP, HYBRIX, MODE, Acu-Loc2P, and DVR were 5.9 ± 1.45 mm, 5.3 ± 0.98 mm, 4.5 ± 1.69 mm, 4.1 ± 1.72 mm, 4.3 ± 1.30 mm, and 6.5 ± 2.25 mm, respectively. The mean dv values for VariAx, VA-TCP, HYBRIX, MODE, Acu-Loc2P, and DVR were 8.2 ± 0.60 mm, 8.0 ± 1.02 mm, 5.6 ± 1.35 mm, 5.6 ± 1.67 mm, 5.1 ± 1.33 mm, and 7.64 ± 2.42 mm, respectively.

The dv value for Acu-Loc2P was significantly smaller than that for VariAx ($p < 0.05$).

IV. Discussion

There have been several reports about the blood supply to the FPL. In the digital area, the FPL tendon is supplied by the vinculum which is the specialized mesotendineum of the synovial sheath that provides the vascular supply to the tendon in the synovial space [19-23]. Vessels from the vinculum enter the dorsum of the flexor pollicis longus and run in a longitudinal direction proximally and distally [19-21, 23].

Revol et al. [24] reported the blood supply of the FPL in fresh cadavers. According to the report, the FPL was supplied mainly by branches from the AIA, and the RA was a secondary feeding vessel. Although there were only a few cases reported, the FPL was also supplied by branches of the ulnar artery. Our study revealed that the AIA supplied more branches to the FPL compared to the RA. These findings are generally in agreement with previous reports.

The FPL tendon is only supplied by the median nerve artery via the synovium and slight blood circulation from the muscle at the level of the distal radius [21]. Therefore, the FPL is considered to be fragile in this area, which is also the location of VLP placement.

In this study, the mean distance from the AC process to the most distal branch of the RA and AIA was 43.0 and 57.0 mm, respectively. We speculated that these branches are exposed in the surgical field, because the length of commercial VLPs is about 50 to 60 mm. The most distal branch of the RA may become damaged because the FPL needs to be continuously retracted towards the ulnar side during surgery. The most distal branch of the AIA was found near the proximal edge of the PQ. Preservation of this vessel is recommended for preventing further deterioration of blood flow to the FPL. Careful detachment of the PQ is necessary and blind operations may increase the risk of injury to this vessel. Surgeons must know these anatomical features to avoid internal bleeding and the development of hematomas, which leads to hand edema.

In the measurement, most of the plates showed dc, dd, and dv values of more than 3 mm. These results indicate that when clinicians use fixed locking plates for comminution fractures and need to hold them directly under the articular surface, distal placement with contact or irritation to the FPL tendon is inevitable[13, 16]. The variable-angle locking system of VariAx and VA-TCP showed larger values. When using variable-angle locking plates, the fixed-type drilling method is inadequate; thus, surgeons should select variable-angle drilling for strong fixation. Kawasaki et al. reported the usefulness of the double-tiered subchondral support procedure with variable angle-locking plates for AO-type C3 fractures [14]. In their method, distal screws supported the central subchondral bone and proximal screws supported the dorsal subchondral bone; therefore, this method can provide relatively wide articular stability. Although a variable-angle locking system can efficiently change the screw location at the dorsal side, the location does not change much at the volar side [13]. Many severe fractures with lunate facet fragments or volar sharing fractures need to be stabilized at the volar articular surface [26-28]. When secure subchondral fixation of the volar fragments is needed, surgeons should avoid using the VariAx and the VA-TCP because the plates have to be placed distally in this situation, resulting in excessive pressure on the FPL tendon [13, 26].

The value for HYBRIX was smaller than all the values for VariAx, dd value for DVR, and dv value for VA-TCP in the hole A. Therefore, surgeons may obtain stronger subchondral support with HYBRIX than with these three plates, when attempting to avoid FPL tendon contact. Throughout the measurement, the values for HYBRIX, MODE, and Acu-Loc2P were smaller than the values for the other three plates; however, the differences were not significant. The smaller values for HYBRIX, MODE, and Acu-Loc2P might be associated with the distribution of these plates after the year 2011 and the fact that these three models are more recent than the other three models. A concept of recent commercial VLP is made to fit to the morphology of the distal radius. Recent plates have a medial extension to fix the lunate facet or a lateral extension to support the lateral rim and radial process [12]. Additionally, HYBRIX and MODE are manufactured by Japanese companies; thus, they would be appropriate for Japanese people and might be suitable for small people of other ethnicities.

The present study had several limitations. First, a comparatively small number of specimens and plates were investigated. Due to normal anatomical variations, a study with a larger sample size is needed. Second, investigation was carried out with formalin-fixed cadavers and without colored latex injections, which may lead to overlooking thin vessels. Third, there is no verification about blood supply to the FPL after VLP surgery. Fourth, although we placed the plate with the best fit in the radial-ulnar position, the plate may not have been placed accurately straight on the radius because of the individual differences in the distal radius. This problem might have affected the measurements. Finally, all specimens were normal without wrist fracture. Patients with wrist fracture might show different results.

This study is clinically relevant because it identifies the feeding vessels to the FPL and related structures at the wrist. This knowledge may assist surgeons in performing VLP surgery with fewer complications. In addition, in this study we were able to verify the distance between the drill and articular surface in lateral radiographs of VLPs placed without FPL contact, which is usually difficult in clinical settings.

V. Conclusion

The blood supply of the FPL was from the branches of the AIA and RA. The most distal branch of the RA can be often damaged during VLP surgery. The distance between the drill and the articular surface was over 3 mm in most measurements when attempting to place VLPs without FPL tendon contact.

When clinicians need to place the locking screw directly under the articular surface, contact between the VLP and FPL tendon is inevitable.

Acknowledgments

The author would like to express their deepest gratitude to professors Jiro Hitomi and Yoichi Sato from the Department of Anatomy of Iwate Medical University for their support of this study.

Conflict of interest: The authors have no conflict of interest to declare.

References

1) **Sirniö K, Flinkkilä T, Vähäkuopus M, et al.**: Risk factors for complications after volar plate fixation of distal radial fractures. J Hand Surg Eur **14**, 1153-1777, 2018.
2) **Fox HM, Thompson AR, Nazir OF, et al.**: Use of a large tenaculum clamp as a reduction technique for treatment of distal radius fractures. J Hand Surg Am **16**, doi: 10.1016/jhsa.2018.11.017, 2018.
3) **Tokutake K, Iwatsuki K, Tatebe M, et al.**: Usefulness of CT-based measurement of volar prominence for evaluation of risk of flexor tendon injury following fixation of a distal radius fracture. J Orthop Sci **24**, 263-268, 2018.
4) **Soong M, Earp BE, Bishop G, et al.**: Volar locking plate implant prominence and flexor tendon rupture. J Bone Joint Surg Am **93**, 328–335, 2011.
5) **Kitay A, Swanstrom M, Schreiber JJ, et al.**: Volar plate position and flexor tendon rupture following distal radius fracture fixation. J Hand Surg Am **38**, 1091–1096, 2013.
6) **Mehling I, Müller LP, Delinsky K, et al.**: Number and locations of screw fixation for volar fixed-angle plating of distal radius fractures: biomechanical study. J Hand Surg Am **35**, 885–891, 2010.
7) **Drobetz H, Bryant AL, Pokorny T, et al.**: Volar fixed-angle plating of distal radius extension fractures: influence of plate position on secondary loss of reduction-a biomechanic study in a cadaveric model. J Hand Surg Am **31**, 615–622, 2006.
8) **StanburySJ, Salo A** and **Elfar JC**: Biomechanical analysis of a volar variable-angle locking plate: the effect of capturing a distal radial styloid fragment. J Hand Surg Am **37**, 2488–2494. 2012.
9) **Mehling I, Klitscher D, Mehling AP, et al.**: Volar fixed-angle plating of distal radius fractures: screws versus pegs-a biomechanical study in a cadaveric model. J Orthop Trauma **26**, 395–401, 2012.
10) **DahlWJ, Nassab PF, Burgess KM, et al.**: Biomechanical properties of fixed-angle volar distal radius plates under dynamic loading. J Hand Surg Am **37**, 1381–1387, 2012.
11) **Garrigues GE, Glisson RR, Garrigues NW, et al.**: Can locking screws allow smaller, low-profile plates to achieve comparable stability to larger, standard plates? J Orthop Trauma **25**, 347–354, 2011.
12) **Limthongthang R, Bachoura A, Jacoby SM, et al.**: Distal radius volar locking plate design and associated vulnerability of the flexor pollicis longus. J Hand Surg Am **39**, 852–860, 2014.
13) **Inagaki K** and **Kawasaki K**: Distal radius fractures-Design of locking mechanism in plate system and recent surgical procedures. J Orthop Sci **21**, 258–262, 2016.
14) **Kawasaki K, Nemoto T, Inagaki K, et al.**: Variable-angle locking plate with or without double-tiered subchondral support procedure in the treatment of intra-articular distal radius fracture. J Orthop Trauma **15**, 271–274, 2014.
15) **Ishikawa H**: The latest treatment strategy for the rheumatoid hand deformity. J Orthop Sci **22**, 583-592, 2017.
16) **Kanayama G, DeLuca J, Meehan WP, et al.**: Ruptured tendons in anabolic androgenic steroid users: a cross-sectional cohort study. Am J Sports Med **43**, 2638-2644, 2015.
17) **Trevor D**: Rupture of the extensor pollicis longus tendon after Colles fracture. J Bone Joint Surg Br **32**, 370-375, 1950.
18) **Helal B, Chen SC** and **Iwegbu G**: Rupture of the extensor pollicis longus tendon in undisplaced Colles' type of fracture. Hand **14**, 41-47, 1982.
19) **Lundborg G**: The vascularization of the human

flexor pollicis longus tendon. Hand **11**, 28-33,1979.
20) **Hergenroeder PT, Gelberman RH** and **Akeson WH**: The vascularity of the flexor pollicis longus tendon. Clin Orthop Relat Res **162**, 298-303, 1982.
21) **Azar CA, Culver JE** and **Fleegler EJ**: Blood supply of the flexor pollicis longus tendon. J Hand Surg **8**, 471-475, 1983.
22) **Armenta E** and **Fisher J**: Anatomy of flexor pollicis longus vinculum system. J Hand Surg **9**, 210-212, 1984.
23) **Zbrodowski A, Gajisin S** and **Bednarkiewicz M**: Mesotendons of the flexor pollicis longus muscle. Acta Anat **151**, 131-137, 1994.
24) **Revol MP, Lantieri L, Loy S, et al.**: Vascular anatomy of the forearm muscles: a study of 50 dissections. Plast Reconstr Surg **88**, 1026-1033, 1991.
25) **Tanaka Y, Aoki M, Izumi T, et al.**: Effect of distal radius volar plate position on contact pressure between the flexor pollicis longus tendon and the distal plate edge. J Hand Surg Am **36**, 1790-1797, 2011.
26) **Harness NG, Jupiter JB, OrbayJL, et al.**: Loss of fixation of the volar lunate facet fragment in fractures of the distal part of the radius. J Bone Joint Surg Am **86**, 1900–1908, 2004.
27) **Beck JD, Harness NG** and **Spencer HT**: Volar plate fixation failure for volar shearing distal radius fractures with small lunate facet fragments. J Hand Surg Am **39**, 670–678, 2014.
28) **O'Shaughnessy MA, Shin AY** and **Kakar S**: Volar marginal rim fracture fixation with volar fragment-specific hook plate fixation. J Hand Surg Am **40**, 1563–1570, 2015.

岩手医誌 71 巻, 4 号（令和元年 10 月）115-125 頁.

橈骨遠位端骨折に対する手術時の合併症を予防するための解剖学的研究

長母指屈筋腱の栄養血管と掌側プレートのスクリュー位置の検討

菊池祐樹 [1)]，佐藤光太朗 [1)]，田島吾郎 [1)]，
燕　　軍 [2)]，村上賢也 [1)]，三又義訓 [1)]，土井田稔 [1)]

[1)] 岩手医科大学医学部，整形外科学講座
[2)] 岩手医科大学医学部，解剖学講座人体発生学分野

(Received on January 22, 2019 & Accepted on February 14, 2019)

要旨

橈骨遠位端骨折に対する掌側ロッキングプレートで，術後合併症として長母指屈筋腱 (以下 FPL) 損傷が報告されている．その原因としてプレートが橈骨掌側の隆起より突出して設置されることにより，腱とプレートとの間に器械的摩擦が生じ断裂すると考えられている．そのため腱を刺激しない位置にプレート設置することが望ましいが，その位置に設置した際の骨折保持能力については報告されていない．また FPL 腱の脆弱化の原因として，手術時の操作による FPL の栄養血管損傷の影響についてもいまだ解明されていない．本研究の目的は FPL の機械的摩擦が生じない位置にプレートを設置した際にインプラントの骨折保持能力の妥当性を検証すること，また FPL の栄養血管を同定して手術による血管損傷の可能性を検討することである．