Joint Diseases and Related Surgery

Jt Dis Relat Surg
2026;37(x):i-vii

ORIGINAL ARTICLE

Correction of volar tilt using the lift technique with fixed-angle volar locking plate in distal radius fractures

Ahmet Alperen Öztürk, MD

Department of Orthopedics and Traumatology, Ağrı Training and Research Hospital, Ağrı, Türkiye

ABSTRACT

Objectives: The aim of this study is to evaluate the radiological effectiveness of restoring volar tilt in dorsally displaced distal radius fractures using the lift technique performed with a fixed-angle volar locking plate.

Patients and methods: Between January 2023 and February 2025, a total of 14 patients (5 males, 9 females; median age: 46.9 years; range, 32 to 72 years) with dorsally displaced intra-articular or extra-articular distal radius fractures who underwent fixation with a fixed-angle volar plate using the visually estimated lift technique were retrospectively analyzed. Fractures were classified according to the AO classification. Pre-lift and post-lift volar tilt angles as well as plate-shaft angles were measured from fluoroscopy images, and control volar tilt angles were measured from radiographs. Actual angular correction was defined as the difference between pre-lift and post-lift volar tilt angles.

Results: Fracture types were AO Type A in nine patients, AO Type C in four patients, and AO Type B in one patient. The median volar tilt angle at the time of fracture was –24.9° (range, –4° to –56°). Following traction and reduction maneuvers, the median pre-lift volar tilt was –4.9° (range, –20° to 4°), the median post-lift volar tilt was 9.5° (range, 0° to 15°), and the median volar tilt at follow-up was 9.4° (range, 1° to 16°). Plate-shaft angles ranged from 6° to 25° (median: 14.2°). Actual angular correction ranged from 5° to 25°. In 11 cases (78.5%), intraoperative correction achieved the target range of 5° to 15°. In three cases (15.4%), volar tilt correction was insufficient, with final values of 0°, 3°, and 4°. The ratio (R) of actual angular correction to theoretical angular correction was approximately 0.67.

Conclusion: The lift technique using a fixed-angle volar plate is a reliable and effective method for intraoperative correction of volar tilt in dorsally displaced distal radius fractures. The technique provides a valuable alternative, particularly in cases where manual reduction fails to achieve sufficient volar tilt restoration.

Keywords: Distal radius fracture, fixed-angle plate, fracture reduction, lift technique, volar tilt.

Distal radius fractures (DRFs) are among the most frequently encountered fractures in emergency departments. Many patients can be managed without surgical intervention; however, cases in which acceptable alignment cannot be achieved require surgical treatment. Open reduction and internal fixation using volar distal radius locking plates is the most commonly used method.[1] Among the radiographic parameters which need to be restored for good functional outcomes in both conservative and surgical treatment of DRFs, volar tilt and ulnar variance are of primary importance.[2-4] In dorsally angulated fractures with metaphyseal comminution, achieving the desired volar tilt may be difficult. Despite anatomical reduction and volar plate fixation, correction of volar tilt often varies widely between undercorrection and overcorrection.[5,6] Negative deviations in volar tilt may alter distal radioulnar joint mechanics, leading to changes in ulnocarpal load transmission and development of adaptive carpal instability.[7,8]

Received: September 24, 2025
Accepted: December 15, 2025
Published online: December 22, 2026

Correspondence: Ahmet Alperen Öztürk, MD. Ağrı Eğitim ve Araştırma Hastanesi, Ortopedi ve Travmatoloji Kliniği, 04200 Ağrı, Türkiye.

E-mail: aalperenozturk@gmail.com

Doi: 10.52312/jdrs.2026.2644.

Citation: Öztürk AA. Correction of volar tilt using the lift technique with fixed-angle volar locking plate in distal radius fractures. Jt Dis Relat Surg 2026;37(x):i-vii. doi: 10.52312/jdrs.2026.2644.

During surgical treatment, after traction and reduction maneuvers, the fracture is temporarily fixed with Kirschner wires (K-wires), followed by plate application to correct volar tilt. However,

in some cases, achieving volar tilt manually is difficult, necessitating the use of additional techniques. After plate fixation proximal to the fracture, partially inserted distal screws can act as a lever to force flexion of the distal fragment, thereby restoring volar tilt.[9] To further improve anatomical restoration of volar tilt, the "lift" technique was developed, in which fixed-angle volar plates are used as a reduction tool, allowing fixation of the distal fragment to the radial shaft at the desired angular correction.[10,11] In cases of inadequate reduction, the volar locking plate can be applied proximally to the radial shaft at an angle, then locked distally at the watershed line, creating a triangular configuration that allows the plate body to act like a joystick for reduction. The lift technique has been shown to be reliable in restoring volar tilt in most fractures.[10-12] In a synthetic foam radius model, fixation of DRFs with volar plates using this technique has also been reported to provide accurate correction of volar tilt.[13] The method can be performed through visual estimation or by using trigonometric calculations to minimize error.[10,11,13-15] Nevertheless, some studies have reported undercorrection or overcorrection of volar tilt with this technique.[10]

In the present study, we aimed to radiologically evaluate the effect of the lift technique, performed with a fixed-angle volar locking plate, on correction of volar tilt in dorsally displaced intra-articular and extra-articular DRFs.

PATIENTS AND METHODS

This single-center, retrospective study was conducted at Ağrı Training and Research Hospital, Department of Orthopedics and Traumatology between January 2023 and February 2025. A total of 14 patients (5 males, 9 females; median age: 46.9 years; range, 32 to 72 years) who underwent correction of volar tilt in DRFs using the lift technique with a fixed-angle volar locking plate by a single surgeon were included. Preoperative, intraoperative, and postoperative radiographic images were analyzed. Cases in which volar tilt could be satisfactorily achieved with traction and manual reduction, as well as cases with incomplete imaging, were excluded. Written informed consent was obtained from each patient. The study protocol was approved by the Ağrı İbrahim Çeçen University Ethics Committee (Date: 29.05.2025, No: 240). The study was conducted in accordance with the principles of the Declaration of Helsinki.

All radiological measurements were performed by an orthopedic and traumatology specialist with experience in hand surgery. On distal radius radiographs, the initial fracture volar tilt angle, pre-lift volar tilt angle, pre-lift volar plate-shaft angle (PSA), post-lift volar tilt angle, and final volar tilt angle were measured using the Smart Correction preoperative planning and templating software system.[16] A line perpendicular to the long axis of the radius was accepted as neutral; volar tilt was recorded as a positive value, while dorsal tilt was recorded as a negative value. Volar tilt values were measured on fluoroscopic images taken intraoperatively before and after application of the lift technique and were defined as pre-lift and post-lift values, respectively. The actual angular correction achieved by the lift technique was defined as the difference between the pre-lift and post-lift volar tilt values. The volar PSA was measured on fluoroscopic images obtained before the proximal portion of the plate was secured to the radial shaft, and this value was accepted as the theoretical angular correction. The ratio (R) was calculated by dividing the actual angular correction by the theoretical angular correction.[10]

Surgical technique

Our applied lift technique consisted of first placing a compression screw followed by other distal locking screws to ensure the plate was fully seated on the watershed line distally, and subsequently using the plate as a lever to correct dorsal malalignment before final fixation to the radial shaft. A standard volar approach was used in all patients, and a 2.4-mm fixed-angle volar distal radius plate (Response Ortho fixed-angle volar LCP system, Response Ortho, Tuzla, Türkiye) was implanted.

Following the standard volar approach, fracture reduction was achieved through traction and manipulation, and temporary stabilization was provided using two or three 1.4-mm K-wires placed either interfocally or intrafocally.[10] In cases where an anatomical volar tilt could not be achieved under fluoroscopic guidance, the distal end of the fixed-angle volar locking plate was positioned -based on visual estimation- on the distal fragment at the watershed line to provide approximately 10° of volar angulation. The plate was then temporarily secured with K-wires (Figure 1). On a true lateral fluoroscopic image, the correction of volar tilt was assessed by the PSA, defined as the angle formed between the proximal part of

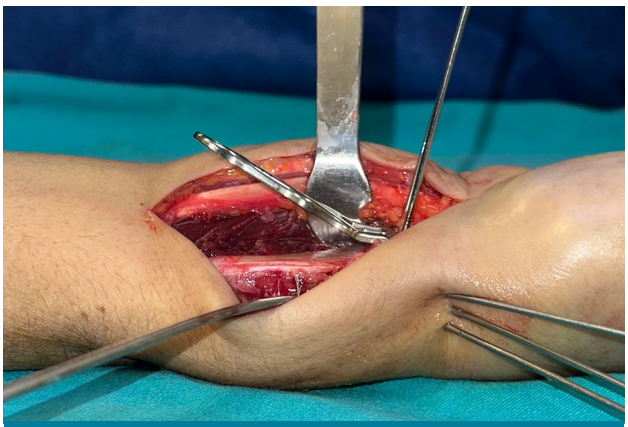

FIGURE 1. Lateral view showing plate positioning for pre-lift volar tilt measurement.

the plate and the volar surface of the radial shaft (Figure 2a). A volar tilt correction equal to the PSA was expected. If an acceptable volar tilt was deemed to have been achieved, the plate was, then, definitively fixed distally to the fragment with a compression screw followed by other locking screws at the watershed line. Plate positioning in anteroposterior and lateral projections and screw placement in 45° pronation oblique views were confirmed fluoroscopically. Subsequently, the proximal portion of the plate, with its distal end already fixed, was used as a lever arm and secured to the radial shaft with a compression screw. The degree of volar tilt correction achieved by this maneuver was verified fluoroscopically. If the volar tilt was within an acceptable range, the proximal locking screws were inserted (Figure 2b). Although volar tilt of 11°±5°[17] is usually accepted, values within 10°±5° were considered acceptable.[17]

Statistical analysis

A post-hoc power analysis was performed based on the paired pre-lift and post-lift volar tilt measurements. The median angular correction achieved with the lift technique was 14.4°, with a standard deviation of 6.49°. Using these values, the effect size for paired measurements was calculated as Cohen's d = 2.21, representing a very large effect. With this effect size, the post-hoc statistical power of the study was determined to be 99.8% at an alpha level of 0.05. Furthermore, a prospective sample size calculation based on the same effect size indicated that a minimum of six patients would be sufficient to achieve 80% statistical power for detecting a similar magnitude of angular correction. Accordingly, despite the relatively small sample size, the study had a sufficiently high statistical power to validate the observed radiological outcomes.

Statistical analysis was performed using the IBM SPSS version 26.0 software (IBM Corp., Armonk, NY, USA).

RESULTS

Among the 14 patients treated with the lift technique for dorsally angulated intra- and extra-articular DRFs, nine had AO Type A, four had AO Type C, and one had AO Type B fractures. Specifically, six of the Type A fractures were AO A2 and

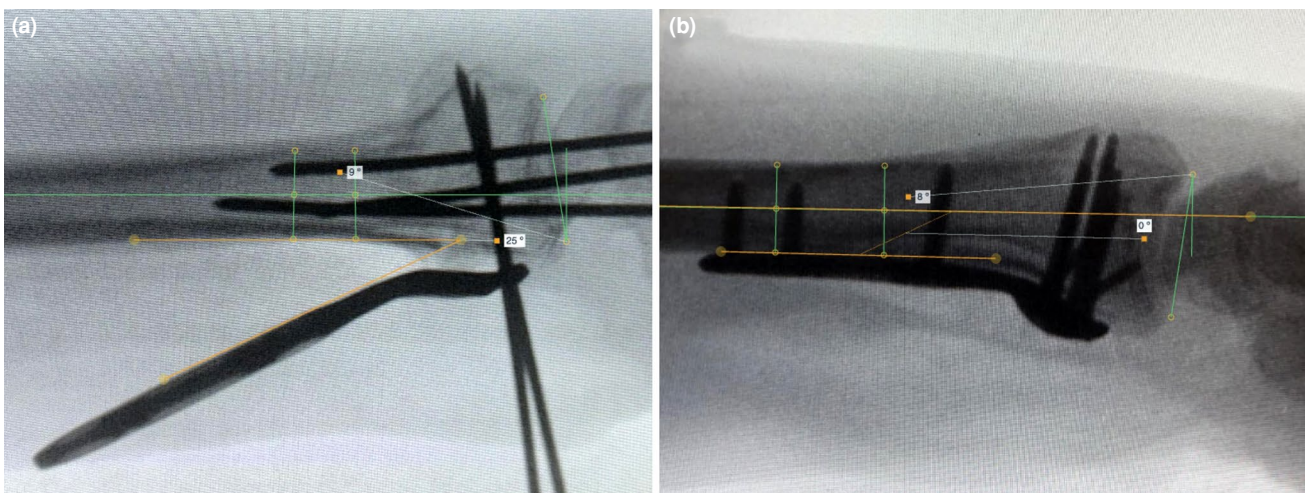

FIGURE 2. Distal radius fracture with dorsal angulation following a fall on the wrist. **(a)** After closed reduction and Kirschner wire fixation, pre-lift volar tilt was –9° and the PSA was 25°. **(b)** With the combination of a fixed-angle plate and the lift technique, dorsal tilt was corrected, and volar tilt was restored to 8° with a PSA of 0°.
PSA: Plate-shaft angle.

TABLE I
Radiological measurements of volar tilt, plate-shaft angle, and angular correction values

Patient no	Fracture volar tilt (°)	Pre-lift volar tilt (°)	Plate-Shaft angle (°)	Post-lift volar tilt (°)	Radiographic volar tilt (°)
1	–8	–2	12	15	16
2	–13	–10	25	15	13
3	–22	1	6	10	8
4	–32	–3	7	10	8
5	–4	–3	8	14	15
6	–49	4	17	12	11
7	–26	–20	19	4	2
8	–56	3	16	11	11
9	–18	–5	9	9	6
10	–16	–8	9	10	13
11	–16	–4	22	15	15
12	–29	–8	14	3	3
13	–22	–9	25	8	9
14	–38	–5	11	0	1
Median	–24.9	–4.9	14.2	9.5	9.4

Fracture volar tilt - pre-lift volar tilt angle; Pre-lift volar tilt - volar tilt measured after reduction and K wire fixation; Plate-shaft angle - theoretical angular correction value; Post-lift volar tilt - volar tilt measured after plate application and completion of the "lift" maneuver; Radiographic volar tilt - volar tilt measured on radiographs; K: Kirschner.

three were AO A3; the Type C fractures were AO C1; and the single Type B fracture was AO B3.[18] Associated injuries included ulnar styloid fractures in three cases, a scaphoid fracture in one case, a scapholunate ligament lesion in one case, and combined scaphoid and ulnar styloid fractures in one case. Fractures were fixed with plates within one to 14 days after injury. The mechanisms of injury included an in-vehicle traffic accident in one patient, skiing injury in two patients, and fall onto the wrist in 11 patients.

At the time of fracture, volar tilt angles ranged from –4° to –56°, with a median of –24.9°. After traction, reduction maneuvers, and K-wire fixation, pre-lift volar tilt angles ranged from –20° to 4° (median: –4.9°). Post-lift volar tilt angles ranged from 0° to 15° (median: 9.5°). At follow-up, volar tilt angles ranged from 1° to 16° (median: 9.4°). Pre-lift PSAs measured after distal fixation of the fixed-angle plate at the watershed line ranged from 6° to 25° (median: 14.2°) (Table I).

Using the lift technique, actual angular correction ranged from 5° to 25°. In 11 of 14 cases (78.5%), intraoperative volar tilt correction achieved the target range of 5°-15°. In three cases (Patient No. 7, 12, and 14; 21.5%), correction was insufficient, with final volar tilt angles of 4°, 3°, and 0°, respectively. The ratio (R) of actual angular correction to theoretical angular correction was calculated to be approximately 0.67.

DISCUSSION

In DRFs, particularly in the presence of marked dorsal metaphyseal comminution, restoration and maintenance of volar tilt is one of the most challenging parameters.[11] Dorsal angulation has been reported as the most important factor affecting functional outcomes in DRFs.[3] Malunion with dorsal angulation has been associated with midcarpal instability, reduced range of motion, and difficulty in performing daily living activities.[2,7,19]

In the present study, the lift technique achieved acceptable volar inclination of 5°-15° in 11 cases (78.5%) with dorsally angulated DRFs. In three cases (21.5%), volar tilt correction was insufficient at 0°, 3°, and 4°, respectively. These findings suggest that the lift technique can provide adequate volar inclination in the majority of dorsally displaced DRFs.

Despite advancements in locked volar plate implant systems and improved surgical techniques, complete restoration of volar tilt may not be possible in dorsally angulated fractures with metaphyseal

comminution. Studies have reported postoperative volar tilt correction ranging from 1° to 8.2° when fractures were treated with locked plating after traction, manipulation, and manual reduction.[5,6,20] Arora et al.[20] reported a mean volar tilt of 2.7°±5.7° (range, −2° to 8°) at the final follow-up. Mignemi et al.[2] found normal volar tilt in only 48% of 185 DRFs treated with volar locking plates. Rozental and Blazar[21] reported a median volar tilt of 4° immediately postoperatively in 41 patients with dorsally displaced DRFs treated with volar locking plates. In contrast, Dario et al.[3] reported restoration of normal volar tilt (7°-15°) in 90.2% of 51 patients with unstable DRFs (range, 3° to 17°). Our study demonstrates that the visually estimated lift technique, when applied using a fixed-angle volar plate, is effective in correcting volar tilt in DRFs.

For the correction of volar tilt, volar inclination can be achieved by forcing the distal fragment into flexion following traction and reduction maneuvers and the application of the plate proximally,[9] as well as by using the lift technique.[10] Park fixes the plate to the proximal part of the fractured radius after traction and manipulation. Volar tilt is corrected by screw manipulation partially inserted into the distal fragment and by direct fragment manipulation with manual pressure. Preoperatively, the mean dorsal tilt was −11.9°±10.4°, while at final follow-up, the volar tilt improved to 10.8°±4.5°.[9] However, as pre-manipulation volar tilt values were not reported, the degree of correction achieved by this method is unclear. In addition, desired correction may not be achieved in osteoporotic fractures using screw-leverage maneuvers alone. Metikala et al.[12] described a reduction technique similar to the lift technique in which a mini-Hohmann retractor was placed between the proximal shaft and the plate, achieving 10° of volar tilt correction.

Several authors have reported favorable results with the lift technique after volar plate fixation at the watershed line.[10,11] Sreedharan et al.[10] applied the lift technique using visual estimation in 24 cases, reporting a median post-lift volar tilt of 10.8° (range, 3° to 20.5°). Acceptable correction of 5° to 15° was achieved in 18 cases, while three cases were overcorrected (15.5°, 16°, 20.5°) and three were undercorrected (3°, 3°, 4°).[10] To minimize errors in over- or undercorrection with the visually estimated lift technique, Sreedharan et al.[10] later described the trigonometry-integrated lift technique (TILT). Using preoperative volar tilt angles and implant dimensions, the required amount of lift for restoring volar tilt was calculated mathematically. Intraoperative measurements were performed with marked transparency overlays on fluoroscopic images. Their study included 27 DRFs (20 AO Type C). Pre-lift volar tilt ranged from 0° to −20°, while post-lift volar tilt ranged from 2° to 16°. Except for three cases, all were within 5° to 15°. The mean volar tilt achieved was 10.2°. With the lift technique integrated with trigonometry, it has been demonstrated that anatomical volar inclination can be reliably restored intraoperatively in DRFs with reduced margin of error. The authors note that the technique may facilitate the attainment of more predictable and acceptable volar tilt values, regardless of the surgeon's experience level, and therefore suggest that it could be considered as a viable option.[11]

Roebke et al.[13] created normal and osteoporotic dorsally angulated extra-articular DRFs in 20 synthetic foam radius models. The osteoporosis group was subjected to additional modification in order to simulate an osteoporotic model. After producing varying degrees of dorsal angulation, opaque markers were placed, and pre-reduction volar tilt was measured fluoroscopically. Using a distal-priority technique with a lift screw, they reported that this method allowed for accurate and precise correction of volar tilt to near-target values.

In our series, 11 of 14 cases (78.5%) in which the lift technique was applied for the correction of dorsal angulation in dorsally displaced DRFs achieved volar inclination between 5° and 15°. In three cases (21.5%), volar tilt was found to be insufficiently corrected with values of 0°, 3°, and 4°. The lift technique was evaluated to provide sufficient volar inclination in DRFs with dorsal angulation. In two cases (Patient No. 7 and 12) in which the desired correction could not be obtained with the lift technique, the fractures were classified as AO type C1, with marked metaphyseal comminution, intra-articular extension, and bone loss. In these patients, the initial volar tilt values were −26° and −29°, with pre-lift volar tilt values of −20° and −8°, respectively. With the lift technique, an angular correction of 24° and 11° was achieved, resulting in final volar tilt angles of 4° and 3°, respectively. In Patient No. 14, the fracture had an initial volar tilt of −38°, with a pre-lift volar tilt of −5°, and a post-lift volar tilt of 0°. In Patient No. 12 and 14, surgery was performed 14 days after the fracture, which is considered to have contributed to the inadequate correction. In the three cases with insufficient restoration, incomplete plate seating on the watershed line,

visual estimation errors during large volar tilt corrections, delayed surgery, bone quality, and fracture pattern were considered potential contributing factors. For improved outcomes, we recommend careful preoperative planning and intraoperative fluoroscopic assessment to enhance the accuracy of visual estimation.

With the visual estimation method, the mean target volar tilt of 10°±5° is based on determining the PSA approximately equal to the required angular correction. Theoretically, the volar tilt correction achieved should equal the PSA. In practice, however, actual correction is usually less than the theoretical PSA. In our study, the ratio (R) of actual to theoretical angular correction was approximately 0.85. In comparison, Sreedharan et al.[10] reported mean PSA of 13.9° (range, 4.5° to 44°) with a mean post-lift volar tilt of 10.8° using visual estimation, and 10.2° using the trigonometry-based method. In the overall cohort, the mean PSA was 14.2° and the mean post-lift volar tilt was 9.5°, corresponding to an R value of 0.67. These ratios suggest that, whether using visual estimation or trigonometry, the measured PSA should be calculated to be approximately 15 to 20% greater than the desired correction to reliably achieve acceptable volar tilt values.

The main limitation to our study is that the pre-lift volar tilt angle was determined based on intraoperative fluoroscopic images through visual estimation without the use of a goniometer, and consequently, PSA adjustment was also based on visual estimation. Since all radiological measurements were performed by a single observer, interobserver reliability could not be assessed, and this may introduce potential observer bias. Another limitation is the retrospective design and the relatively small sample size. Further multi-center, large-scale, prospective studies including functional outcomes are needed to further validate our findings.

In conclusion, our study results suggest that the visually estimated lift technique, when used with a fixed-angle volar plate, may be effective in restoring volar tilt in DRFs. The effectiveness of the technique appears to depend on accurate alignment between the plate and distal fragment, appropriate selection of the PSA angle, and proper fluoroscopic positioning and image interpretation. Particularly, in cases where manual reduction does not provide sufficient volar tilt correction, the visually guided lift technique may serve as a practical and reliable option. Further studies are needed to confirm these findings.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflict of Interest: The author declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding: The author received no financial support for the research and/or authorship of this article.

REFERENCES

1. Kiyoshige Y. Condylar stabilizing technique with AO/ASIF distal radius plate for colles' fracture associated with osteoporosis. Tech Hand Up Extrem Surg 2002;6:205-8. doi: 10.1097/00130911-200212000-00009.
2. Mignemi ME, Byram IR, Wolfe CC, Fan KH, Koehler EA, Block JJ, et al. Radiographic outcomes of volar locked plating for distal radius fractures. J Hand Surg Am 2013;38:40-8. doi: 10.1016/j.jhsa.2012.10.007.
3. Dario P, Matteo G, Carolina C, Marco G, Cristina D, Daniele F, et al. Is it really necessary to restore radial anatomic parameters after distal radius fractures? Injury 2014;45 Suppl 6:S21-6. doi: 10.1016/j.injury.2014.10.018.
4. Jupiter JB, Fernandez DL. Comparative classification for fractures of the distal end of the radius. J Hand Surg Am 1997;22:563-71. doi: 10.1016/S0363-5023(97)80110-4.
5. Stevenson I, Carnegie CA, Christie EM, Kumar K, Johnstone AJ. Displaced distal radial fractures treated using volar locking plates: Maintenance of normal anatomy. J Trauma 2009;67:612-6. doi: 10.1097/TA.0b013e3181ad8d4d.
6. Musgrave DS, Idler RS. Volar fixation of dorsally displaced distal radius fractures using the 2.4-mm locking compression plates. J Hand Surg Am 2005;30:743-9. doi: 10.1016/j.jhsa.2005.03.006.
7. Park MJ, Cooney WP 3rd, Hahn ME, Looi KP, An KN. The effects of dorsally angulated distal radius fractures on carpal kinematics. J Hand Surg Am 2002;27:223-32. doi: 10.1053/jhsu.2002.32083.
8. Nishiwaki M, Welsh M, Gammon B, Ferreira LM, Johnson JA, King GJ. Distal radioulnar joint kinematics in simulated dorsally angulated distal radius fractures. J Hand Surg Am 2014;39:656-63. doi: 10.1016/j.jhsa.2014.01.013.
9. Park JW, Kim YH, Park KC, Lee JI. A novel technique for full anatomic restoration of volar tilt in distal radius fracture. Acta Orthop Traumatol Turc 2015;49:115-9. doi: 10.3944/AOTT.2015.14.0247.
10. Sreedharan S, Mohd Fadil MF, Lim WS. Intra-operative correction of volar tilt of distal radius fractures using volar locking plate as reduction tool: Review of 24 cases. Hand Surg 2014;19:363-8. doi: 10.1142/S0218810414500282.
11. Sechachalam S, Satku M, Wong JH, Tan LT, Yong FC. Trigonometry-Integrated 'Lift' Technique (TILT) for restoring volar tilt in distal radius fractures: Description of technique and preliminary results. J Hand Surg Asian Pac Vol 2017;22:53-8. doi: 10.1142/S0218810417500095.
12. Metikala S, Purudappa PP, Cheppalli NS. A simple tool for volar tilt restoration during volar plate osteosynthesis of distal radius fracture: A technical note. Trauma Case Rep 2023;43:100760. doi: 10.1016/j.tcr.2023.100760.
13. Roebke AJ, Martin AS, Sarmast Z, Fisk E, Goyal KS. Lift-off screw results in accurate sagittal tilt correction in a distal radius fracture model. J Hand Surg Am 2018;43:523-8. doi: 10.1016/j.jhsa.2018.02.011.

14. Schneppendahl J, Windolf J, Kaufmann RA. Distal radius fractures: Current concepts. J Hand Surg Am 2012;37:1718-25. doi: 10.1016/j.jhsa.2012.06.001.
15. Park JH, Hagopian J, Ilyas AM. Variable-angle locking screw volar plating of distal radius fractures. Hand Clin 2010;26:373-80. doi: 10.1016/j.hcl.2010.04.003.
16. Goldfarb CA, Yin Y, Gilula LA, Fisher AJ, Boyer MI. Wrist fractures: What the clinician wants to know. Radiology 2001;219:11-28. doi: 10.1148/radiology.219.1.r01ap1311.
17. Medoff RJ. Essential radiographic evaluation for distal radius fractures. Hand Clin 2005;21:279-88. doi: 10.1016/j.hcl.2005.02.008.
18. Meinberg EG, Agel J, Roberts CS, Karam MD, Kellam JF. Fracture and dislocation classification compendium-2018. J Orthop Trauma 2018;32 Suppl 1:S1-170. doi: 10.1097/BOT.0000000000001063.
19. McQueen M, Caspers J. Colles fracture: Does the anatomical result affect the final function? J Bone Joint Surg Br 1988;70:649-51. doi: 10.1302/0301-620X.70B4.3403617.
20. Arora R, Lutz M, Hennerbichler A, Krappinger D, Espen D, Gabl M. Complications following internal fixation of unstable distal radius fracture with a palmar locking-plate. J Orthop Trauma 2007;21:316-22. doi: 10.1097/BOT.0b013e318059b993.
21. Rozental TD, Blazar PE. Functional outcome and complications after volar plating for dorsally displaced, unstable fractures of the distal radius. J Hand Surg Am 2006;31:359-65. doi: 10.1016/j.jhsa.2005.10.010.