CQ HAND + UPPER LIMB
SPECIALIST ORTHOPAEDIC SURGEON

EVIDENCE SUMMARY

Flexor Tendon Repair

Overview

- Flexor tendon repair in Zone II is a technically demanding procedure, but outcomes have become more predictable and satisfying [1].
- No gold standard has been determined for the optimal flexor tendon repair algorithm, and repairs are usually chosen based on familiarity, popularity, and technical difficulty [2].
- Zone I flexor tendon injuries traditionally have not yielded results as good as other flexor tendon injuries, with full motion rarely regained and good/excellent results reported in only up to 67% of cases [4].
- Despite improvements in surgical technique and rehabilitation, functional outcomes for flexor tendon injuries remain unreliable, with adhesion formation and joint contractures being the most common complications [5].
- Secondary reconstruction remains an important and useful technique for complicated flexor tendon injuries or those that have failed primary repair [6].
- Consistent, successful management of flexor tendon injuries relies on understanding the anatomy, characteristics and repair of tendons in the different zones, potential complications, rehabilitation protocols, recent advances in treatment, and future directions, including tissue engineering and biologic modification of the repair site [7].
- Tendon grafting is the treatment of choice for flexor tendon injuries in zones I and II when direct repair is not possible or delayed [8].
- Limited evidence currently exists for zones IV and VII extensor and for flexor tendon repairs regarding relative motion orthoses for early active motion [10].
- Many of the principles of flexor tendon repair and rehabilitation can be applied to zones III–V [11].
- Primary flexor tendon repair in the digital sheath area has become standard practice with a shift toward strong multistrand core sutures and modified pulley preservation [12].
- A modified protocol for primary flexor tendon repair in zones 1 and 2 utilizes a 6-strand core suture without circumferential suturing, selective pulley division, and partial FDS resection to facilitate early active motion and improve outcomes [19].

CQ HAND + UPPER LIMB
Dr Kieran Hirpara — Specialist Orthopaedic Surgeon
Suite 2, Level 1, Mater Private Hospital Rockhampton, 31 Ward Street, The Range, QLD 4700
Phone 07 4863 6556 · office@cqupperlimb.com.au · cqupperlimb.com.au

Anatomy & Pathophysiology

- Flexor tendons function as cables that transmit forces to move and stabilize joints [31].
- An understanding of flexor tendon biomechanics is essential for the proper evaluation and treatment of upper extremity disorders [31].
- A thorough understanding of flexor tendon anatomy and the mechanism of injury is critical for diagnosis, treatment, and postoperative management [47].
- Adhesion formation is the most common complication following flexor tendon injuries [5].
- Joint contractures are the most common complication following flexor tendon injuries [5].
- Functional outcomes for flexor tendon injuries remain unreliable despite improvements in surgical technique and rehabilitation [5].
- Therapists must understand the implications of wrist and metacarpophalangeal (MCP) joint positioning to safely facilitate tendon gliding [36].
- Proper wrist and MCP joint positioning helps prevent secondary pathomechanical changes during rehabilitation [36].
- Complex hand injuries involving flexor tendon disruption require management of associated soft tissue and bony injuries to optimize functional outcomes [43].

Classification

- Flexor tendon repair in Zone II is a technically demanding procedure [1].
- Outcomes for acute flexor tendon repairs in Zone II have become more predictable and satisfying [1].
- No gold standard has been determined for the optimal flexor tendon repair algorithm [2].
- Flexor tendon repair techniques are usually chosen based on familiarity, popularity, and technical difficulty [2].
- Zone I flexor tendon injuries traditionally have not yielded results as good as other flexor tendon injuries [4].
- Full motion is rarely regained in Zone I flexor tendon injuries [4].
- Good or excellent results are reported in only up to 67% of Zone I flexor tendon injury cases [4].
- Secondary reconstruction remains an important and useful technique for complicated flexor tendon injuries [6].
- Secondary reconstruction remains an important and useful technique for flexor tendon injuries that have failed primary repair [6].
- Consistent, successful management of flexor tendon injuries relies on understanding the anatomy, characteristics, and repair of tendons in the different zones [7].
- Tendon grafting is the treatment of choice for flexor tendon injuries in zones I and II when direct repair is not possible or delayed [8].

- Many principles of flexor tendon repair and rehabilitation can be applied to zones III–V [11].
- Primary flexor tendon repair in the digital sheath area has become standard practice [12].
- There is a shift toward strong multistrand core sutures in primary flexor tendon repair in the digital sheath area [12].
- There is a shift toward modified pulley preservation in primary flexor tendon repair in the digital sheath area [12].
- Despite significant advances, the drive towards perfection in flexor tendon repair and reconstruction continues [13].
- Flexor tendon injuries are complex [14].
- Management of flexor tendon injuries requires consideration of surgical timing [14].
- Management of flexor tendon injuries requires consideration of injury location [14].
- Management of flexor tendon injuries requires consideration of approach [14].
- Management of flexor tendon injuries requires consideration of soft tissue handling [14].
- Understanding the role that growth factors play in tendon repair should enable a more targeted approach to improve the results of flexor tendon repair [18].
- Currently, no strategies targeting growth factors are routinely used in clinical practice for flexor tendon repair [18].
- Subdividing Zone 2 is key to improving outcomes in flexor tendon repair [40].
- Releasing critical pulleys (A2 and A4) is key to improving outcomes in flexor tendon repair [40].
- Using strong multi-strand repairs with early active motion is key to improving outcomes in flexor tendon repair [40].

Clinical Presentation

- Flexor tendon injuries are complex, requiring consideration of surgical timing, injury location, approach, and soft tissue handling [14].
- Acute flexor tendon repair in Zone II is a technically demanding procedure with outcomes that have become more predictable and satisfying [1].
- No gold standard has been determined for the optimal flexor tendon repair algorithm; repairs are usually chosen based on familiarity, popularity, and technical difficulty [2].
- Zone I flexor tendon injuries traditionally have not yielded results as good as other flexor tendon injuries, with full motion rarely regained and good/excellent results reported in only up to 67% of cases [4].
- Despite improvements in surgical technique and rehabilitation, functional outcomes for flexor tendon injuries remain unreliable [5].
- Adhesion formation and joint contractures are the most common complications after flexor tendon repair [5].

- Tendon adhesion and joint contracture are managed through prevention, meticulous surgical technique, and thoughtful rehabilitation protocols [26].
- Repair ruptures were documented in most reports with rates ranging from 4%-10% in finger flexors and 3%-17% in FPL of thumbs [16].
- Spontaneous flexor tendon ruptures of the hand occur more often than one might recognize, with the majority involving the profundus tendon of the small finger in the palm [23].
- Closed flexor tendon disruptions include traumatic avulsion, spontaneous midsubstance rupture, attrition rupture, infiltrative tenosynovial rupture, and iatrogenic causes [32].
- Pediatric flexor tendon injuries differ from adults in diagnosis and rehabilitation, often requiring surgical exploration due to uncooperative patients [17].
- Secondary reconstruction remains an important and useful technique for complicated flexor tendon injuries or those that have failed primary repair [6].
- Consistent, successful management of flexor tendon injuries relies on understanding the anatomy, characteristics and repair of tendons in the different zones, potential complications, rehabilitation protocols, recent advances in treatment, and future directions [7].
- The central tenet of modern flexor tendon surgery is to increase tendon healing and avoid adhesion formation by making a repair strong enough to move within a few days of injury [15].
- Understanding the role that growth factors play in tendon repair should enable a more targeted approach to be developed to improve the results of flexor tendon repair, although currently no strategies are routinely used in clinical practice [18].
- Future techniques, such as tissue engineering, may provide better functional results [25].
- Recent incremental improvements in clinical outcomes suggest that new biologic strategies, such as cell-based strategies and tissue engineering, may be useful adjuncts to further improve current clinical outcomes in flexor tendon surgery [33].
- The large heterogeneity in the outcome domains being assessed/measured across studies highlights the need for a consistent core outcome set to be measured in future clinical research on hand flexor tendon injuries [9].
- Limited evidence currently exists for zones IV and VII extensor and for flexor tendon repairs regarding relative motion orthoses for early active motion [10].

Investigations

- Flexor tendon repair in Zone II is a technically demanding procedure, but outcomes have become more predictable and satisfying [1].
- No gold standard has been determined for the optimal flexor tendon repair algorithm, and repairs are usually chosen based on familiarity, popularity, and technical difficulty [2].

- Despite improvements in surgical technique and rehabilitation, functional outcomes for flexor tendon injuries remain unreliable, with adhesion formation and joint contractures being the most common complications [5].
- Consistent, successful management of flexor tendon injuries relies on understanding the anatomy, characteristics and repair of tendons in the different zones, potential complications, rehabilitation protocols, recent advances in treatment, and future directions, including tissue engineering and biologic modification of the repair site [7].
- Limited evidence currently exists for zones IV and VII extensor and for flexor tendon repairs regarding the use of relative motion orthoses for early active motion [10].
- Many of the principles of flexor tendon repair and rehabilitation can be applied to zones III–V [11].
- Primary flexor tendon repair in the digital sheath area has become standard practice with a shift toward strong multistrand core sutures and modified pulley preservation [12].
- Despite significant advances in flexor tendon repair and reconstruction, the drive towards perfection continues [13].
- Initial clinical experience is encouraging and the volar plate flap technique may take its place in flexor tendon surgery [20].
- Late direct repair is possible in a small proportion of patients (approximately 1 in 10 to 1 in 15) where tendon ends can be approximated with acceptable tension [21].
- Despite aggressive and prompt antibiotic therapy and surgical intervention, even otherwise healthy patients can expect some residual digital stiffness following flexor tendon sheath infection [30].

Treatment

- Flexor tendon repair in Zone II is technically demanding, but outcomes have become more predictable and satisfying [1].
- Flexor tendon repairs are usually chosen based on familiarity, popularity, and technical difficulty [2].
- Adhesion formation is the most common complication after flexor tendon injuries [5].
- Joint contractures are the most common complication after flexor tendon injuries [5].
- Secondary reconstruction is an important and useful technique for complicated flexor tendon injuries [6].
- Secondary reconstruction is an important and useful technique for flexor tendon injuries that have failed primary repair [6].
- Consistent, successful management of flexor tendon injuries relies on understanding the anatomy, characteristics, and repair of tendons in different zones [7].
- Consistent, successful management of flexor tendon injuries relies on understanding potential complications [7].
- Consistent, successful management of flexor tendon injuries relies on understanding rehabilitation protocols [7].

- Consistent, successful management of flexor tendon injuries relies on understanding recent advances in treatment [7].
- Future directions in flexor tendon injury management include tissue engineering and biologic modification of the repair site [7].
- Tendon grafting is the treatment of choice for flexor tendon injuries in zones I and II when direct repair is not possible [8].
- Tendon grafting is the treatment of choice for flexor tendon injuries in zones I and II when repair is delayed [8].
- Limited evidence currently exists for relative motion orthoses after finger extensor tendon repairs in zones IV and VII [10].
- Limited evidence currently exists for relative motion orthoses after flexor tendon repairs in zones IV and VII [10].
- There is a shift toward strong multistrand core sutures in primary flexor tendon repair [12].
- There is a shift toward modified pulley preservation in primary flexor tendon repair [12].
- The central tenet of modern flexor tendon surgery is to increase tendon healing and avoid adhesion formation [15].
- Modern flexor tendon surgery aims to make a repair strong enough to move within a few days of injury [15].
- Pediatric flexor tendon injuries differ from adults in diagnosis and rehabilitation [17].
- Pediatric flexor tendon injuries often require surgical exploration due to uncooperative patients [17].
- Understanding the role of growth factors in tendon repair should enable a more targeted approach to improve flexor tendon repair results [18].
- A modified protocol for primary flexor tendon repair in zones 1 and 2 utilizes a 6-strand core suture without circumferential suturing [19].
- A modified protocol for primary flexor tendon repair in zones 1 and 2 utilizes selective pulley division [19].
- A modified protocol for primary flexor tendon repair in zones 1 and 2 utilizes partial FDS resection to facilitate early active motion and improve outcomes [19].
- Initial clinical experience with the volar plate of the distal interphalangeal joint as a distally based flap in flexor tendon surgery is encouraging [20].
- The volar plate flap technique may take its place in flexor tendon surgery [20].
- Prompt recognition of problems after flexor tendon injury treatment may help minimize recovery time and improve function [22].
- Treatment of problems after flexor tendon injury with hand therapy, splinting, and/or surgery may help minimize recovery time and improve function [22].
- Preoperative, operative, and postoperative considerations are key for flexor tenolysis [24].
- Patient selection is as key to success in flexor tenolysis as the operative procedure itself [24].
- Cooperation is as key to success in flexor tenolysis as the operative procedure itself [24].

- A rational goal is as key to success in flexor tenolysis as the operative procedure itself [24].
- Tendon adhesion and joint contracture are the most common complications after flexor tendon repair [26].
- Tendon adhesion and joint contracture after flexor tendon repair are managed through prevention, meticulous surgical technique, and thoughtful rehabilitation protocols [26].
- Some authors no longer perform flexor tendon repair with tourniquet, sedation, or muscle paralysis in zones 1 and 2 [37].
- There is not sufficient evidence to support true active motion as an effective or preferable choice for flexor tendon rehabilitation at this time [38].
- There is a lack of superior benefits following true active motion regimens for flexor tendon rehabilitation [38].
- There is currently limited evidence informing the use of relative motion flexion orthoses following zone I-III flexor tendon repair [45].
- Increasing the number of suture strands significantly improves the mechanical strength and gap resistance of flexor tendon repairs [48].
- Using locking-loop configurations significantly improves the mechanical strength and gap resistance of flexor tendon repairs [48].
- Optimizing suture purchase length significantly improves the mechanical strength and gap resistance of flexor tendon repairs [48].

Complications

- Adhesion formation is one of the most common complications following flexor tendon injuries [5].
- Joint contractures are one of the most common complications following flexor tendon injuries [5].
- Residual digital stiffness is expected even in otherwise healthy patients following flexor tendon sheath infection, despite aggressive and prompt antibiotic therapy and surgical intervention [30].
- Repair rupture rates for finger flexors range from 4% to 10% [16].
- Repair rupture rates for the flexor pollicis longus (FPL) of thumbs range from 3% to 17% [16].
- Repair rupture rates are reported at 2% to 5% for tendons repaired with 4-strand or 6-strand core sutures [49].
- Very low to zero incidence of rupture is reported for Zone 2 repairs in some contexts [50].
- Late direct repair is possible in approximately 1 in 10 to 1 in 15 patients where tendon ends can be approximated with acceptable tension [21].
- Prompt recognition of problems and treatment with hand therapy, splinting, and/or surgery may help minimize recovery time and improve function [22].

Recovery

- A modified protocol for primary flexor tendon repair in zones 1 and 2 utilizes a 6-strand core suture without circumferential suturing, selective pulley division, and partial FDS resection to facilitate early active motion and improve outcomes [19].
- Repeated administration of sodium hyaluronate at the tendon repair site may be effective in improving postoperative active finger motion after primary hand flexor tendon repair in the mid-term [27].
- The author recommends the partial-range active flexion protocol as a safe, efficient, and generalizable framework for rehabilitation after flexor tendon repair and other hand disorders, particularly where therapist assistance is unavailable [28].
- Future research is suggested to increase understanding of repair strength, optimal age ranges for early active motion, and cost-effectiveness in children [29].
- Rehabilitation after surgical repair of flexor injuries is a controversial topic where motion at the repair site decreases risk for adhesions but increases risk for rupture [34].

Key Evidence

- [L5] Flexor tendon repair in Zone II is a technically demanding procedure, but outcomes have become more predictable and satisfying. [1] (10.1016/j.hcl.2004.11.001)
- [L5] No gold standard has been determined for the optimal flexor tendon repair algorithm, and repairs are usually chosen based on familiarity, popularity, and technical difficulty. [2] (10.1016/j.jhsa.2014.06.025)
- [L5] Zone I flexor tendon injuries traditionally have not yielded results as good as other flexor tendon injuries, with full motion rarely regained and good/excellent results reported in only up to 67% of cases. [4] (10.1016/j.hcl.2004.12.004)
- [L5] Despite improvements in surgical technique and rehabilitation, functional outcomes for flexor tendon injuries remain unreliable, with adhesion formation and joint contractures being the most common complications. [5] (10.1016/j.hcl.2009.11.004)
- [L5] Secondary reconstruction remains an important and useful technique for complicated flexor tendon injuries or those that have failed primary repair. [6] (10.1016/j.jhsa.2007.08.018)
- [L5] Consistent, successful management of flexor tendon injuries relies on understanding the anatomy, characteristics and repair of tendons in the different zones, potential complications, rehabilitation protocols, recent advances in treatment, and future directions, including tissue engineering and biologic modification of the repair site. [7] (10.5435/jaaos-d-16-00316)
- [L5] Tendon grafting is the treatment of choice for flexor tendon injuries in zones I and II when direct repair is not possible or delayed. [8] (10.1016/j.hcl.2004.12.003)
- [L2] The large heterogeneity in the outcome domains being assessed/measured across studies highlights the need for a consistent core outcome set to be measured in future clinical research on hand flexor tendon injuries. [9] (10.1177/17531934251342732)

- [L1] Limited evidence currently exists for zones IV and VII extensor and for flexor tendon repairs. [10] (10.1016/j.jht.2023.02.011)
- [L5] Many of the principles of flexor tendon repair and rehabilitation can be applied to zones III–V. [11] (10.1016/j.hcl.2004.11.007)
- [L5] Primary flexor tendon repair in the digital sheath area has become standard practice with a shift toward strong multistrand core sutures and modified pulley preservation. [12] (10.1016/j.hcl.2013.02.003)
- [L5] Despite significant advances in flexor tendon repair and reconstruction, the drive towards perfection continues. [13] (10.1177/17531934251404821)
- [L5] Flexor tendon injuries are complex, and management requires consideration of surgical timing, injury location, approach, and soft tissue handling. [14] (10.1016/j.jhsa.2024.05.013)
- [L4] The central tenet of modern flexor tendon surgery is to increase tendon healing and avoid adhesion formation by making a repair strong enough to move within a few days of injury. [15] (10.1016/j.hcl.2013.03.001)
- [L4] Repair ruptures were documented in most reports with rates ranging from 4%-10% in finger flexors and 3%-17% in FPL of thumbs. [16] (10.1016/j.hcl.2004.11.005)
- [L5] Pediatric flexor tendon injuries differ from adults in diagnosis and rehabilitation, often requiring surgical exploration due to uncooperative patients. [17] (10.1016/j.hcl.2004.11.004)
- [L5] Understanding the role that growth factors play in tendon repair should enable a more targeted approach to be developed to improve the results of flexor tendon repair, although currently no strategies are routinely used in clinical practice. [18] (10.1177/1753193413509231)
- [L5] The authors describe a modified protocol for primary flexor tendon repair in zones 1 and 2 that utilizes a 6-strand core suture without circumferential suturing, selective pulley division, and partial FDS resection to facilitate early active motion and improve outcomes. [19] (10.1016/j.hcl.2017.03.001)
- [L4] Initial clinical experience is encouraging and the volar plate flap technique may take its place in flexor tendon surgery. [20] (10.1016/j.jhsa.2015.11.004)
- [L4] Late direct repair is possible in a small proportion of patients (approximately 1 in 10 to 1 in 15) where tendon ends can be approximated with acceptable tension. [21] (10.1016/j.hcl.2013.02.004)
- [L5] Prompt recognition of problems and treatment with hand therapy, splinting, and/or surgery may help minimize recovery time and improve function. [22] (10.5435/00124635-200607000-00001)
- [L4] Spontaneous flexor tendon ruptures of the hand occur more often than one might recognize, with the majority involving the profundus tendon of the small finger in the palm. [23] (10.1016/j.jhsa.2007.06.012)
- [L5] The article outlines preoperative, operative, and postoperative considerations for flexor tenolysis, emphasizing that patient selection, cooperation, and a rational goal are as key to success as the operative procedure itself. [24] (10.1016/j.hcl.2004.11.008)
- [L5] Future techniques, such as tissue engineering, may provide better functional results. [25] (10.5435/jaaos-d-14-00195)

- [L5] Tendon adhesion and joint contracture are the most common complications after flexor tendon repair, managed through prevention, meticulous surgical technique, and thoughtful rehabilitation protocols. [26] (10.1016/j.hcl.2014.12.004)
- [L1] Repeated administration of sodium hyaluronate at the tendon repair site may be effective in improving postoperative active finger motion after primary hand flexor tendon repair in the mid-term. [27] (10.1016/j.jhsa.2021.07.012)
- [L5] The author recommends the partial-range active flexion protocol as a safe, efficient, and generalizable framework for rehabilitation after flexor tendon repair and other hand disorders, particularly where therapist assistance is unavailable. [28] (10.1177/17531934211037112)
- [L5] Future research is suggested to increase understanding of repair strength, optimal age ranges for early active motion, and cost-effectiveness. [29] (10.1016/j.jht.2014.12.002)
- [L5] Despite aggressive and prompt antibiotic therapy and surgical intervention, even otherwise healthy patients can expect some residual digital stiffness following flexor tendon sheath infection. [30] (10.5435/jaaos-20-06-373)
- [L5] An understanding of the biomechanics of the flexor tendon system is essential to proper evaluation and treatment of disorders of the upper extremity, as the tendons function as cables transmitting forces to move and stabilize joints. [31] (10.1016/j.hcl.2004.11.002)
- [L5] This article reviews different causes, diagnoses, and treatment options of closed flexor tendon disruptions, including traumatic avulsion, spontaneous midsubstance rupture, attrition rupture, infiltrative tenosynovial rupture, and iatrogenic causes. [32] (10.1016/j.jhsa.2014.04.005)
- [L5] Recent incremental improvements in clinical outcomes suggest that new biologic strategies, such as cell-based strategies and tissue engineering, may be useful adjuncts to further improve current clinical outcomes in flexor tendon surgery. [33] (10.1016/j.hcl.2005.01.001)
- [L5] Rehabilitation after surgical repair of flexor injuries is a controversial topic where motion at the repair site decreases risk for adhesions but increases risk for rupture. [34] (10.1016/j.jhsa.2019.02.010)
- [L5] Therapists must understand the implications of wrist and MCP joint positioning to safely facilitate tendon gliding and prevent secondary pathomechanical changes. [36] (10.1177/17531934241265579)
- [L5] The authors no longer perform flexor tendon repair with tourniquet, sedation, or muscle paralysis. [37] (10.1016/j.hcl.2013.02.009)
- [L1] Based on a lack of superior benefits following true active motion regimens, there is not sufficient evidence to support true active motion as an effective or preferable choice for flexor tendon rehabilitation at this time. [38] (10.1016/j.jht.2018.06.001)
- [L5] The article reviews a three-decade research journey demonstrating that subdividing Zone 2, releasing critical pulleys (A2 and A4), and using strong multi-strand repairs with early active motion are key to improving outcomes in flexor tendon repair. [40] (10.1177/17531934221087585)
- [L5] Complex hand injuries involving flexor tendons require a physician-therapist team approach and management of associated soft tissue and bony injuries to optimize functional outcomes. [43] (10.1016/j.hcl.2004.12.001)

- [L4] There is currently limited evidence informing use of relative motion flexion orthoses following flexor tendon repair. [45] (10.1016/j.jht.2022.11.004)
- [L5] A thorough understanding of the anatomy and mechanism of injury is critical for diagnosis, treatment, and postoperative management. [47] (10.1016/j.csm.2019.12.004)
- [L5] Increasing the number of suture strands, using locking-loop configurations, and optimizing suture purchase length significantly improve the mechanical strength and gap resistance of flexor tendon repairs. [48] (10.1016/j.jhsa.2009.12.044)
- [L1] Over the past 10 years, surgeons have reported good to excellent results in about 80% or more of tendons repaired with 4-strand or 6-strand core sutures, with 2% to 5% repair ruptures. [49] (10.1016/j.hcl.2013.02.007)
- [L5] Outcomes of Zone 2 repairs are not dissimilar to those in other zones with very low to zero incidence of rupture. [50] (10.1177/17531934211053757)

References

[1] Acute Flexor Tendon Repairs in Zone II. *Hand Clinics*. 2005. DOI: 10.1016/j.hcl.2004.11.001

[2] Flexor Tendon Repairs: Techniques, Eponyms, and Evidence. *The Journal of Hand Surgery*. 2014. DOI: 10.1016/j.jhsa.2014.06.025

[4] Zone I Flexor Tendon Injuries. *Hand Clinics*. 2005. DOI: 10.1016/j.hcl.2004.12.004

[5] Complications After Flexor Tendon Injuries. *Hand Clinics*. 2010. DOI: 10.1016/j.hcl.2009.11.004

[6] Secondary Flexor Tendon Reconstruction, A Review. *The Journal of Hand Surgery*. 2007. DOI: 10.1016/j.jhsa.2007.08.018

[7] Flexor Tendon Injuries. *Journal of the American Academy of Orthopaedic Surgeons*. 2018. DOI: 10.5435/jaaos-d-16-00316

[8] Delayed Treatment of Flexor Tendon Injuries Including Grafting. *Hand Clinics*. 2005. DOI: 10.1016/j.hcl.2004.12.003

[9] Developing a core outcome set for hand flexor tendon injuries: a systematic review of treatment outcomes. *Journal of Hand Surgery (European Volume)*. 2025. DOI: 10.1177/17531934251342732

[10] Relative motion orthoses for early active motion after finger extensor and flexor tendon repairs: A systematic review. *Journal of Hand Therapy*. 2023. DOI: 10.1016/j.jht.2023.02.011

[11] Treatment of Acute Flexor Tendon Injury: Zones III–V. *Hand Clinics*. 2005. DOI: 10.1016/j.hcl.2004.11.007

[12] Current Practice of Primary Flexor Tendon Repair. *Hand Clinics*. 2013. DOI: 10.1016/j.hcl.2013.02.003

[13] The IFSSH consensus and current guidelines on flexor tendon repairs and reconstruction. *Journal of Hand Surgery (European Volume)*. 2026. DOI: 10.1177/17531934251404821

CQ HAND + UPPER LIMB
Dr Kieran Hirpara — Specialist Orthopaedic Surgeon
Suite 2, Level 1, Mater Private Hospital Rockhampton, 31 Ward Street, The Range, QLD 4700
Phone 07 4863 6556 · office@cqupperlimb.com.au · cqupperlimb.com.au

[14] Flexor Tendon Injuries. *The Journal of Hand Surgery*. 2024. DOI: 10.1016/j.jhsa.2024.05.013

[15] Primary Flexor Tendon Surgery. *Hand Clinics*. 2013. DOI: 10.1016/j.hcl.2013.03.001

[16] Clinical Outcomes Associated with Flexor Tendon Repair. *Hand Clinics*. 2005. DOI: 10.1016/j.hcl.2004.11.005

[17] Pediatric Flexor Tendon Injuries. *Hand Clinics*. 2005. DOI: 10.1016/j.hcl.2004.11.004

[18] The growth factors involved in flexor tendon repair and adhesion formation. *Journal of Hand Surgery (European Volume)*. 2013. DOI: 10.1177/1753193413509231

[19] Primary Flexor Tendon Repair with Early Active Motion. *Hand Clinics*. 2017. DOI: 10.1016/j.hcl.2017.03.001

[20] Use of the Volar Plate of the Distal Interphalangeal Joint as a Distally Based Flap in Flexor Tendon Surgery. *The Journal of Hand Surgery*. 2016. DOI: 10.1016/j.jhsa.2015.11.004

[21] Uncommon Methods of Flexor Tendon and Tendon-Bone Repairs and Grafting. *Hand Clinics*. 2013. DOI: 10.1016/j.hcl.2013.02.004

[22] Complications After Treatment of Flexor Tendon Injuries. *Journal of the American Academy of Orthopaedic Surgeons*. 2006. DOI: 10.5435/00124635-200607000-00001

[23] Spontaneous Flexor Tendon Ruptures of the Hand: Case Series and Review of the Literature. *The Journal of Hand Surgery*. 2007. DOI: 10.1016/j.jhsa.2007.06.012

[24] Flexor Tenolysis. *Hand Clinics*. 2005. DOI: 10.1016/j.hcl.2004.11.008

[25] Flexor Tendon Reconstruction. *Journal of the American Academy of Orthopaedic Surgeons*. 2016. DOI: 10.5435/jaaos-d-14-00195

[26] Management of Complications of Flexor Tendon Injuries. *Hand Clinics*. 2015. DOI: 10.1016/j.hcl.2014.12.004

[27] Effectiveness of Sodium Hyaluronate and ADCON-T/N for the Prevention of Adhesions in Hand Flexor Tendon Surgery: A Systematic Review and Meta-Analysis. *The Journal of Hand Surgery*. 2022. DOI: 10.1016/j.jhsa.2021.07.012

[28] Rehabilitation after flexor tendon repair and others: a safe and efficient protocol. *Journal of Hand Surgery (European Volume)*. 2021. DOI: 10.1177/17531934211037112

[29] Flexor tendon injuries in children: Rehabilitative options and confounding factors. *Journal of Hand Therapy*. 2015. DOI: 10.1016/j.jht.2014.12.002

[30] Flexor Tendon Sheath Infections of the Hand. *Journal of the American Academy of Orthopaedic Surgeons*. 2012. DOI: 10.5435/jaaos-20-06-373

[31] Biomechanics of the Flexor Tendons. *Hand Clinics*. 2005. DOI: 10.1016/j.hcl.2004.11.002

[32] Closed Flexor Tendon Ruptures. *The Journal of Hand Surgery*. 2014. DOI: 10.1016/j.jhsa.2014.04.005

[33] The Future of Flexor Tendon Surgery. *Hand Clinics*. 2005. DOI: 10.1016/j.hcl.2005.01.001

[34] Postsurgical Rehabilitation of Flexor Tendon Injuries. *The Journal of Hand Surgery*. 2019. DOI: 10.1016/j.jhsa.2019.02.010

[36] Zone-specific pitfalls in flexor tendon rehabilitation: management and prevention. *Journal of Hand Surgery (European Volume)*. 2024. DOI: 10.1177/17531934241265579

[37] Wide-awake Flexor Tendon Repair and Early Tendon Mobilization in Zones 1 and 2. *Hand Clinics*. 2013. DOI: 10.1016/j.hcl.2013.02.009

[38] Flexor tendon rehabilitation in the 21st century: A systematic review. *Journal of Hand Therapy*. 2019. DOI: 10.1016/j.jht.2018.06.001

[40] Investigations into flexor tendon repair: a research journey over three decades. *Journal of Hand Surgery (European Volume)*. 2022. DOI: 10.1177/17531934221087585

[43] Complex Injuries Including Flexor Tendon Disruption. *Hand Clinics*. 2005. DOI: 10.1016/j.hcl.2004.12.001

[45] Relative motion flexion following zone I-III flexor tendon repair: Concepts, evidence and practice.. *Journal of Hand Therapy*. 2023. DOI: 10.1016/j.jht.2022.11.004

[47] Evaluation and Treatment of Flexor Tendon and Pulley Injuries in Athletes. *Clinics in Sports Medicine*. 2020. DOI: 10.1016/j.csm.2019.12.004

[48] Technical and Biological Modifications for Enhanced Flexor Tendon Repair. *The Journal of Hand Surgery*. 2010. DOI: 10.1016/j.jhsa.2009.12.044

[49] Outcomes and Evaluation of Flexor Tendon Repair. *Hand Clinics*. 2013. DOI: 10.1016/j.hcl.2013.02.007

[50] Flexor tendon repair: recent changes and current methods. *Journal of Hand Surgery (European Volume)*. 2021. DOI: 10.1177/17531934211053757

CQ HAND + UPPER LIMB
Dr Kieran Hirpara — Specialist Orthopaedic Surgeon
Suite 2, Level 1, Mater Private Hospital Rockhampton, 31 Ward Street, The Range, QLD 4700
Phone 07 4863 6556 · office@cqupperlimb.com.au · cqupperlimb.com.au