Flexor Tendon Repair Rehabilitation Review

Table:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Study | Level of Evidence: # of patients | Flexor Zones | Rehabilitation Method(s) | Total Time Splinted, Follow-up | Suture Repair Method | Functional Results (%active motion – injured versus non-injured) | Complications |
| Adolfsson, L et al., “The effects of a shortened postoperative mobilization programme after flexor tendon repair in zone 2” | Level I – RCT  82 patients  91 digits | Zone II | First six weeks: passive flexion-active extension  Next six weeks: randomized into full activity after 8 weeks or full activity after 10 weeks | 6 weeks  Follow up at 6 months | Modified Kessler | Louisville:  Group A: 71% good-excellent  Group B: 67% good-excellent  Tsuge:  Group A: 77% good-excellent  Group B: 73% good-excellent  Buck-Gramcko:  Group A: 91% good-excellent  Group B: 91% good-excellent  No significant difference in functional results, grip strength, or subjective assessment.  Absence from work was reduced by 2.1 weeks with shorter mobilization progra | 6 ruptures (5 prior to week 7 and 1 in group A)  No significant difference in rupture rates |
| Baktir, A et al., “Flexor tendon repair in zone 2 followed by early active mobilization” | Level II – Prospective  71 patients and 88 tendons | Zone II | Early postoperative mobilization  33 patients Kleinert rubber band passive flexion/active extension method  38 patients early active mobilization | 6 weeks  Follow up at 1 year | Modified Kessler | 78% good-excellent and 84% mean grip strength in passive flexion group  85% good-excellent and 90% mean grip strength in active mobilization group  Strickland criteria | 2 ruptures in each group |
| Bal S et al., “Anatomic and functional improvements achieved by rehabilitation in zone II and zone V flexor tendon injuries” | Level II – Prospective,  31 patients and 78 digits | Zone II, V | Early passive mobilization – modified Kleinhart protocol | 3 weeks  Follow up 52 weeks for zone II, 55 weeks for zone V (mean) | Modified Kleinhert | 52% good-excellent in zone II  83% good-excellent in zone V  American Society for Surgery of the Hand  Grip strength:  71% zone II  53% zone V | Zone II ruptures (2)  Zone V ruptures (1) |
| Braga-Silva, J et al., “Early active mobilization after flexor tendon repairs in zone two” | Level III – Retrospective  82 patients  136 tendons | Zone II | Early active mobilization | 3 weeks  Follow up 12-36 month range | Modified Kessler | Long fingers: 98% good-excellent (Strickland), 82% good (IFSSH)  Thumb: 96% good-excellent (Strickland), 96% good-excellent (IFSSH)  International Federation of Societies for Surgery of the Hand (IFSSH) and Strickland criteria | 5 ruptures |
| Bunker T, “Continuous passive motion following flexor tendon repair.” | Level II – Prospective  20 patients  35 digits | Zones I-V | Toronto Mobilimb Continuous Motion machine for 4.5 weeks | 6 weeks  Follow up averaged 10.6 months | Modified Mason-Allen sutures | 85% good-excellent (Buck-Gramcko criteria)  70% good-excellent (Kleinert criteria – stricter due to extension criteria) | 2 ruptures |
| Cetin, A et al., “Rehabilitation of flexor tendon injuries by use of a combined regimen of modified Kleinert and modified Duran techniques” | Level  37 patients  74 digits | Zones I-V | Controlled mobilization – combine modified Kleinert and modified Duran techniques – Kleinert splint with a palmer pulley | 4 weeks  **\*need more info** | Modified Kessler | 97% good-excellent  Buck-Gramcko criteria | 1 rupture |
| Chai, S et al., “Dynamic traction and passive mobilization for the rehabilitation of zone II flexor tendon injuries: a modified regime” | Level III – Retrospective  8 patients  15 digits | Zone II | Dynamic traction and passive motion | **\*need more information**  Follow up at 3 months | **\*need more information** | 93% good-excellent  Strickland’s criteria  Grip strength 50% of uninjured hand | **No rupture** |
| Chan, T et al., “Functional outcomes of the hand following flexor tendon repair at the ‘no man’s land’” | Level III – Retrospective  16 patients with 21 digits | Zone II | 7 week rehab: 3 weeks active extension/passive flexion, 2 weeks active flexion without resistance, 2 weeks active flexion with resistance | 3 weeks  Follow up at 130 days | Modified Kessler | 81% good-excellent  (Buck-Gramcko II score) | 1 rupture |
| Chow, J et al., “Controlled motion rehabilitation after flexor tendon repair and grafting” | Level II – Prospective  66 patients  78 digits | Zone II | Washington regimen (controlled motion divided into three stages of two weeks each) – controlled active extension against passive flexion by rubber band and controlled passive extension/flexion | 6 weeks  Follow up from 6 mo – 5 years | Modified Kessler suture or Tajima suture | 98% good-excellent  Strickland criteria | 3 ruptures |
| Elliot, D et al., “The rupture rate of acute flexor tendon repairs mobilized by the controlled active motion regimen” | Level II – Prospective  233 patients and 317 tendons | Zones I, II | Controlled active motion | 4 weeks  Follow up at 3 months | Tajima, Kirchmayr, or Kessler techniques | 77% good-excellent  Strickland criteria | 18 ruptures |
| Edinburg M, “Early postoperative mobilization of flexor tendon injureis using a modification of the Kleinert technique” | Level III – Retrospective  36 patients  99 digits | Zones I-V | Modified Kleinert – early mobilization | 6 weeks  Follow up averaged 3.2 months | Modified Kessler | 61% good-excellent  Buck-Gramcko criteria | 2 ruptures |
| Gelberman, R et al., “Influences of the protected passive mobilization interval on flexor tendon healing. A prospective randomized clinical study” | Level II – RCT  51 patients | Zones I-V | Passive-motion:  -Group 1: greater intervals of passive-motion with continuous passive-motion device – 75hrs/week with 12,000 cycles (48 tendons)  -Group 2: traditional early passive motion – 4hrs/week with 1000 cycles (54 tendons) | 6 weeks  Follow up at 6 months | Kessler and Missim techniques | Group 1 ROM: 138 +/- 6 degrees.  Group 2 ROM: 119 +/-8 degrees  Statistically significant difference between groups  Strickland and Glogovac’s criteria | 0 ruptures in group 1  1 ruptures in group 2 |
| Gerard, F et al., “Immediate active mobilization after flexor tendon repairs in Verdan’s zones I and II. A prospective study of 20 cases” | Level II – Prospective  20 repairs | Zones I, II | Early active mobilization – “patient encouraged to actively and synchronously flex all fingers as many times as possible starting day five” | 4 weeks | Double loop suture of Tsuge with PDS4/0 with peritendinous overrun using Prolene 6/0 | Mean active mobility 70% for zone I and 85% for zone II  Strickland criteria | None  \* protocol meant for injuries with poor initial prognosis (contused tendons, associated fractures) |
| Gerbino, P et al., “Complications experienced in the rehabilitation of zone I flexor tendon injuries with dynamic traction splinting” | Level III – Retrospective  20 tendons | Zone I | 12 week rehabilitation protocol: controlled active extension against passive flexion by rubber band and the use of controlled passive extension and flexion | 6 weeks  Follow up from 6-42 months | Modified Kessler | 65% good-excellent  Strickland criteria | 8 complications (1 rupture, 7 with inability to actively flex at DIP joint) |
| Hatanaka, H et al., “Aggressive active mobilization following zone II flexor tendon repair using a two-strand heavy-gauge locking loop technique” | Level II – Prospective  7 digits | Zone II | Active mobilization with full range of flexion and extension | **\*need more info**  Follow up at 6 months | Two-stranded locking loop using heavy 2/0 braided polyester suture | 86% good-excellent  Strickland criteria | **None reported** |
| Hung et al., “Active mobilization after flexor tendon repair: comparison of results following injuries in zone 2 and other zones” | Level II - Prospective, 32 patients and 46 digits | Zone I, II, III, V | Early active mobilization started POD #3 with passive flexion, active wrist flexion/extension with passive proximal joint gliding  POD 7-10: Active flexion | 3 weeks  F/u at 3, 6, 9, 12 weeks | Modified Kessler | 71% good-excellent in zone II  77% good-excellent in other zones  Pinch grips were similar between groups with 95% that of uninjured hand  American Society of Surgery of the Hand | Zone II ruptures (2)  Other zone ruptures (1) |
| Kasashima et al., “Factors influencing prognosis after direct repair of the flexor pollicis longus tendon: multivariate regression model analysis” | Level III – Retrospective,  29 patients | Zones I, II, III of FPL only | 16 patients immobilized in static splint.  13 patients dynamic flexion splints with passive flexion and active extension exercise. | Immobilization for 3 weeks.  Dynamic flexion for 3 weeks.  Follow up average: 3.1 years (range: 6mo-12yrs) | Modified Kessler or Tsuge | Immobilization: 50% good-excellent (JSSH Method)  Dynamic: 77% good-excellent (JSSH Method)  Injured thumb active motion/contralateral uninjured thumb active motion | Decrease in pinch strength (3), numbness (3) – treatment for each not specified |
| Kayali, C et al., “The results of primary repair and early passive rehabilitation in zone II flexor tendon injuries in children” | Level II - Prospective  23 patients and 25 tendons | Zone II | Passive flexion-extension started on POD 1 according to Duran technique | 4.5 weeks  Mean follow up at 49 months (range 12-92) | Modified Kessler with above elbow stabilization splint | 92% good-excellent  Glocovac and Strickland’s criteria | **None listed** |
| Kitsis, C et al., “Controlled active motion following primary flexor tendon repair: a prospective study over 9 years” | Level II – Prospective  130 patients  339 tendons | Zones I-V | Active motion combined with modified Kleinert dynamic traction splint | 5-6 weeks  Follow up at 6 months | High-strength multistrand technique using modified Kessler core and Halsted peripheral stitch | 92% good-excellent  Strickland criteria | 6 ruptures,  17 contractures or adhesions |
| Klein, L et al., “Early active motion flexor tendon protocol using one splint” | Level III – Retrospective  40 digits | Zones I-III | Active motion – dorsal blocking splint with fingers in rubber band traction for five weeks | 5 weeks  Follow up at 12 weeks | Four strand | 95% good-excellent in zone II  88% good-excellent in zones I, III  DASH scores listed | 1 rupture - patient non-compliant |
| Peck, F et al., “A comparative study of two methods of controlled mobilization of flexor tendon repairs in zone II” | Level II – Prospective  52 patients  52 digits  92 tendons | Zone II | Group 1: Controlled active motion  Group 2: Modified Kleinert regime  26 patients each | 6 weeks  Follow up at 12 weeks | Modified Kessler | Group 1: 85% good-excellent  Group 2: 69% good-excellent  Strickland criteria | Rupture was less in modified Kleinert (7.7%) than in controlled active motion (46%) |
| Percival, N. “Flexor pollicis longus tendon repair: a comparison between dynamic and static splintage” | Level III – Retrospective  51 patients | Zone II, III | Immobilization (25 patients) vs. Dynamic traction (26 patients) | 4 weeks  Follow up at 9 weeks | Modified Kessler | Dynamic mobilization: 60% good-excellent  Fixed splinting: 44% good-excellent  Buck-Gramcko criteria | 8% rupture rate for both groups  Immobilization: 6 patients with no ROM at IP joints  Dynamic traction: 1 patient with no ROM at IP joints |
| Saini et al., “Outcome of early active mobilization after flexor tendons repair in zones II-V in hand” | Level II – Prospective  75 digits | Zones II-V | Modified Kleinert’s regimen and Silfverskiold regimen – active extension with initial active flexion and later passive flexion | 12 weeks  Follow up at 14 weeks | Modified Kessler | 82% good-excellent  Louisville system | 2 ruptures  2 contractures  1 superficial infection  1 flap necrosis |
| Saldana, M et al., “Further experience in rehabilitation of zone II flexor tendon repair with dynamic traction splinting” | Level III - Retrospective  57 patients  60 digits | Zone II | 12 week protocol from US military combined regimen of controlled motion – active extension against rubber band with passive flexion, passive extension with passive flexion  Palmer pulley modification of Kleinert’s dynamic traction splint | 6 weeks  Follow up 12-48 months | Modified Kessler suture | 93% good-excellent  Strickland’s criteria | 3 ruptures |
| Savage, R et al., “Flexor tendon repair using a “six strand” method of repair and early active mobilization” | Level II – Prospective  36 tendons | Zones I, II | Early ective mobilization | 3-4 weeks  Follow up at 3 months | “six strand” method | 100% good-excellent in zone I  69% good-excellent in zone II  Overall, 81% good-excellent  Buck-Gramcko assessment | 1 dehiscence,  2 delayed skin healing,  1 reflex sympathetic dystrophy,  1 adhesion |
| Silfverskiold, K et al., “Flexor tendon repair in zone II with a new suture technique and an early mobilization program combining passive and active flexion” | Level II – Prospective  46 patients  55 digits | Zone II | Active extension and passive/active flexion | **\*need more info**  Follow up 6 weeks and 6 months | Cross-stitch | DIP and PIP had 82% and 88% of ROM compared to other hand, respectively | 2 ruptures  \*focused on new suture technique more than rehab protocol |
| Sirotakova M, et al., “Early active mobilization of primary repairs of the flexor pollicis longus tendon.” | Level II – Prospective  118 patients  -Group A: 30  -Group B: 39  -Group C:49 | Zones I-V | Group A: early active motion with only thumb splinted  Group B: early active motion with thumb and fingers splinted  Group C: early active motion with thumb and fingers splinted | 8 weeks  Follow up averaged 13 weeks | Group A: Kessler suture and simple epitendinous suture  Group B: Kessler suture and simple epitendinous suture  Group C: Kessler suture and reinforced epitendinous suture | Group A: 70/73% good-excellent  Group B: 67/72% good-excellent  Group C: 76/80% good-excellent  White/Buck-Gramcko criteria | Group A: 5 ruptures (17%)  Group B: 6 ruptures (15%)  Group C: 4 ruptures (8%) |
| Small J et al., “Early active mobilization following flexor tendon repair in Zone II” | Level II – Prospective  114 patients and 138 tendons | Zone II | Early active mobilization | 6 weeks  Follow up at 6 months | Profundus tendons: Kessler-Mason-Allen suture  Superficialis tendons: horizontal mattress suture | 77% good-excellent  ASSH | 11 rupture |
| Su, B et al. “Device for zone-II flexor tendon repair. A multicenter reandomized, blinded, clinical trial.” | Level I – RCT  67 patients  85 digits | Zone II | Modified Kleinert with active flexion starting at four weeks postop | 6 weeks  Follow up at 6 months | 34 digits treated with Teno Fix  51 digits with four-stranded cruciate suture repair – control group | No difference in ROM, DASH, grip strength, pain, swelling, or neurologic recovery.  67% good-excellent in TenoFix  70% good-excellent in control | TenoFix:  0 ruptures, 1 wound infection  9 ruptures in control |
| Trumble et al., “Zone-II Flexor Tendon Repair: A Randomized Prospective Trail of Active Place-and-Hold Therapy Compared with Passive Motion Therapy” | Level I – RCT  103 patients and 119 digits | Zone II | Passive motion 51 patients with 58 digits  Active motion 52 patients with 61 digits | Total splinted time unknown  Follow up at 6, 12, 26, 52 weeks | Strickland method – two core sutures (four strands) of 3-0 polyester material and a running epitendinous suture (6-0 monofilament Prolene) | Active motion IP joint motion was 156®+/-25® with 94% good-excellent  Passive motion IP joint motion was 128®+/-22® with 62% good-excellent | Two tendon ruptures in each group |
| Yen, C et al., “Clinical results of early active mobilization after flexor tendon repair” | Level II – Prospective  20 patients | Zone II | Active extension, progressive passive full flexion - 10 patients  Kleinert splint (active hold in dorsal block splint) - 10 patients | 6 weeks  Follow up at 4 months | Four-strand core suture and 6/0 circumferential sutures | Active extension/passive flexion – 70% good-excellent  Kleinert splint – 0% good-excellent  Mayo Wrist Score | No complications in active extension  In Kleinert splint, 1 rupture |