

Surgical Restoration of Grasp Control in Tetraplegia

Akademisk avhandling

För avläggande av medicine doktorsexamen vid Sahlgrenska akademien vid Göteborgs Universitet kommer att offentligen försvaras i Aulan, Sahlgrenska Universitetssjukhuset, torsdagen den 14 mars, 2013, kl 09.00

av

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Avhandlingen baseras på följande delarbeten:

- I. **Selective release of the digital extensor hood to reduce intrinsic tightness in tetraplegia.**
Reinholdt C, Fridén J. J Plast Surg Hand Surg 2011; 45: 83-89.
- II. **A single-stage operation for reconstruction of hand flexion, extension, and intrinsic function in tetraplegia: the alphabet procedure.**
Fridén J, Reinholdt C, Turcsányi I, Gohritz A. Tech Hand Up Extrem Surg 2011; 15: 230-235.
- III. **Rebalancing the tetraplegic wrist using extensor carpi ulnaris-tenodesis.**
Reinholdt C, Fridén J. J Hand Surg Eur 2013; 38: 22-28.
- IV. **Outcomes of the alphabet procedure for grip reconstruction in tetraplegia.**
Reinholdt C, Fridén J. Manuscript.
- V. **Alteration of finger and wrist flexor kinematics after surgical intervention on the spastic hand in tetraplegia.**
Reinholdt C, Fridén J. Manuscript



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ABSTRACT

Aim: The overall aim of this thesis was to improve the grasp and release function of patients with tetraplegia undergoing reconstructive hand surgery. In order to reach this objective, new and more cost-efficient surgical concepts with maintained patient safety were designed.

Patients and methods: 112 individuals were assessed pre- and postoperatively on their pinch and grip strength, range of motion (ROM), hand opening, as well as a satisfactory score (COPM) (retrospective comparative studies I-IV) and dynamic electro-goniometry to assess spasticity (prospective pilot study V).

Results: **I:** Selective release of tight interossei muscles in the hand (distal ulnar intrinsic release) increased the ROM up to 45 %. **II:** The alphabet procedure (a single-stage combination of procedures) reliably provided tetraplegic patients with pinch, grasp and release function after only one operation and one rehabilitation period. **III:** The extensor carpi ulnaris tenodesis corrected radial deviation deformity of the wrist joint and increased the grip strength by double. **IV:** Patients who underwent the alphabet procedure demonstrated significantly more grip strength and opening of the hand compared with patients, who had traditional grip reconstruction. Early active rehabilitation was particularly important after multiple simultaneous procedures. **V:** Dynamic electro-goniometry proved a feasible method to assess spasticity-reducing surgery by measuring joint angular velocity and repetitions per second. Together with COPM, these assessment points can be used to evaluate the outcome of surgery or non-operative spasticity treatments.

Conclusion: This thesis reports development and refinement of several surgical techniques that individually and combined, facilitate the reanimation of grasp control in people with tetraplegia. Rebalancing of the hand by selective release and tendon lengthening techniques enables more favorable mechanical conditions for the forearm, wrist and finger actuators in patients with tightness and spasticity. Shorter total time in the operation room and for rehabilitation with preserved patient safety enforce the recommendation of applying these techniques.

Keywords: alphabet procedure, distal intrinsic release, ECU-tenodesis, electro-goniometry, grasp and release, grip strength, intrinsic tightness, opening of the 1st web space, pinch strength, spasticity, tendon transfer, tetraplegia

ISBN: 978-91-628-8613-4