

SURGERY OF FLEXOR TENDONS

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Flexor tendons injuries pose a major problem because they occur very often and they lead to serious malfunctions. The procedure for acute lesions has been described well and the results are usually satisfactory. Whereas the results in late reconstructions fail to satisfy both the surgeon and the patient.

What we call late reconstruction is the treatment after at least four weeks after injury in adults and at least six weeks in children. Before that time, it is possible to perform end-to-end tendon suture, which has better results. Reconstruction should be made as soon as possible. Although it is possible to achieve satisfactory effect even ten years after injury. The condition needed for operation is complete healing of the wound and full passive flexion. The most common reason for reconstruction, instead of end-to-end suture, is misdiagnosis and the lack of hand surgery centers in some countries.

The methods of flexor tendons reconstruction:

- 1) staged tendon reconstruction which is the standard method,
- 2) superficialis tendon transfer - this is performed exceptionally and only in the zone III to V. The FDS tendon of the intact finger is cut and sutured with the proximal end of the injured FDP tendon. After such a junction an immediate controlled mobilization is recommended
- 3) interpositional graft is performed also in the zone III-V . For this graft we can use also the removed part of tendon. What is recommended here is to joint the distal FDP tendon with the proximal FDS tendon.
- 4) end-to-side juncture is performed seldom and only in zone V. In some exceptional cases it is possible to do it in zone III. In this method we join the distal end of the injured tendon with the neighboring intact tendon using interweaving technique.
- 5) tenolysis in our material some 10% of cases require this method. Indications are usually reported by the patients during controls.
- 6) tenodesis and arthrodesis these are recommended in elderly patients and manual workers or in larger injury when only FDP tendon is injured. When the FDP tendon is injured in other patients the method of treatment should be discussed carefully with the patients. What has to be remembered is that FDP reconstruction with the full function of FDS can worsen the condition of the hand.

Flexor tendon grafting. The operation has to be made under tourniquet. The Bruner zig-zag or midlateral incision can be made. In our opinion, the Bruner method is better as it gives wider exposure it is less traumatic and the scar is easier to be involved in the incision line. After preparation the important structure should be identified and, if needed, nerve reconstruction should be performed but in a way as to achieve the full range of motion. Depending on the range of injury II stage reconstruction or I can be performed. The ranges of injury are well described in

Boyes classification.

The one stage reconstruction can be made in the first and the second grade of Boyes scale. In the remaining grades, the two-stage reconstruction is recommended especially if pulleys A2 and A4 are damaged. The pulleys reconstruction can be made using tendon or a segment of extensor retinaculum. After identifying the structure injured flexor tendons are removed from the sheath. Then at least three pulleys should be made. After this in a I-stage reconstruction, we perform insertion of palmaris or plantaris tendons into the gap using the same technique as in the second stage of the two-stage technique. In II-stage reconstruction, a silicon rod is inserted.

The distal end of the silicon rod is fixed to the FDP stump and the proximal end is placed loose in the zone five or rarely in the zone three. Grafts between zones one and three give worse results and they are performed exceptionally for example if there are many tendons reconstructed. Instead of the classical rod, an active tendon implant can be used.

During the passive exercises, the X-ray control of the rod and its excursion is recommended especially just before the second stage. On the X-ray in the flexion you can see fold of the silicon rod.

The rod is replaced by an autogenous tendon after 8 to 12 weeks. Although other authors recommend a longer period. From two small incisions over each end of the rod we expose the ends. Then the tendon graft is harvested. The best graft for harvesting is plantaris tendon. And this is because it is easy to harvest and it has the proper length. This can be best done using the tubular stripper. The palmaris tendon is even more accessible yet usually it is too short. In about 10% of the cases there may occur the lack of these tendons so then we can harvest the long extensor of second to fourth toe. Exceptionally EIP or EDM tendon can be used.

The end of the harvested tendon is sutured to the rod and during removing of the rod the graft is introduced. We have to remember not to twist the graft while introducing it. Using the Pulvertaft interlace method the proximal end of the tendon graft is sutured to the FDS or, in exceptional cases, to the FDP stump. The distal end is inserted to the distal phalanx and this is called Bunnell's technique. Other methods are interweaving through the base of the distal phalanx or suture to the FDP stump. In our Department we used a modified Bunnell's technique. The tendon graft goes through the distal phalanx and the nail plate. After skin suture the graft is pulled in order to establish the proper tension and then is fixed to the nail. After four to six weeks the protruding part falls off spontaneously.

After reconstruction we immobilize the hand in a plaster cast for three weeks. The position of immobilization is in flexion: the wrist 30-40 degrees, MP 40-60 degrees, PIP 30-40 degrees, DIP 10-20 degrees. Other authors prefer PIP and DIP in extension. The plaster cast is below elbow but in children we apply it above the elbow. In most cases the first change of dressing is done after 3 weeks.

After this time active flexion exercises are started, followed, after another week, by combined extension and flexion exercise.

In our Hand Surgery Department the results of treatment of 538 reconstructions of flexor tendons of the fingers in their inveterate lesions were analyzed. Out of this

number 245 reconstructions were one-stage reconstructions and 293 were two-stage reconstructions in all of which silicon implants were used. The age of the patients ranged from 3 to 72 years, the average being 36 years. 10% were children, 20% women and 70% were men. One finger injury was most common – 68%, 20% were two finger injuries, 5% three and 7% four finger injuries.

Extension of the injury was classified according to Boys classification. And so 7% were first grade injuries, 11% were second grade injuries, 17% were third grade, 38% were fourth grade, and 27% were the most acute fifth grade injury. As you can see, as much as 65% of all these cases were the most severe injuries.

Results. Based on Total Active Motion Techniques finger flexion was estimated. Also grasp power was measured.

According to TAM classification out of the total number of patients 12% of the results were excellent, good and fair were 32% each and 24% poor. The results was divided into I-stage and II-stage operations. Excellent and good results are almost comparable for both procedures. Differences occur in fair and poor results. We can say that II-stage reconstructions give more satisfactory results.

In the group of younger patients we achieved better results. The worst results can be observed in the group of patients over sixty. Analyzing the influence of the grade of the injury, in Boys preoperative classification, on the final results we find that II-stage operation are much better especially in fourth and fifth injuries. II-stage reconstruction is highly recommended when tendon injury occurs together with nerve lesion.

For a reconstruction we have an option of using either FDS motor or FDP motor. In our material we achieved better results with the FDS motor. The pinch strength after tendon reconstruction doesn't resume the norm. It is decreased much more than the grip strength yet the loss is not so great. It results from the fact that in pinch strength measurement only pulp of the digits is involved while in grip strength the whole hand. To compensate the loss, the strength of the opposite hand increases. We achieved better result using a long tendon graft.

On the left picture you can see loosening of the insertion of the silicon rod. Fortunately the distal end of the rod stopped on the last pulley. On the right the problem with skin healing are visible. This situation required additional skin plasty.

To improve the range of movement we use splints but not sooner than 8 weeks after operation. On the last picture we can see the changes on the finger nail which were caused by the fixation of distal tendon graft.

Most often tenolysis is done after I stage reconstruction. And it is like a second stage of this reconstruction. Tenolysis is technically difficult and one has to remember that a radical approach can result in tendon rupture. Yet in majority of cases the range of movement, after using this method, increases.

Conclusions. Two stage tendon reconstruction is recommended and gives better results especially in severe injuries. With nerve and vessel injuries the results are much poorer. We found out that FDS used as a motor makes the reconstruction better. Long tendon graft gives better result. Considering the age of the patients the younger patient the better result are achieved. Precision and grip strength is never the same as before reconstruction. The power of the opposite hand increases.