

Summary of Literature on Skeletal Fixation Devices
for Flexion Contractures of the PIP Joint

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Sept. 2002

A number of skeletal fixation devices have been used to reduce flexion contractures of the PIP joint. Among those reported in the literature are the TEC, Pipster, JESS, Verona, Multiplaner Distracter, and S Quattro. Of these devices, the TEC has received the most investigation regarding its affect on contractures associated with Dupuytren's disease.

The Continuous Extension Technique (TEC) device was constructed in 1986 by A. Messina. The underlying principle for the device was that continuous passive traction applied over a 2 to 4 week period could reduce or eliminate, preoperatively, a flexion contracture concomitant with Dupuytren's disease. Once the digit was straightened, a fasciectomy then could be performed more easily. In 1991, Messina and Messina [1] reported a description of the device and their technique for installation and adjustment of the device. Their clinical results from 30 hands during that 5 year period were reported as generally good.

In 1993, Messina and Messina reported in more detail their clinical results from 51 patients (56 hands, 85 fingers) during the same 5 year period [2]. Patients in this study were affected by grades III and IVb Dupuytren's contracture. Some patients received the device only while others were treated preoperatively with the device followed by a fasciectomy. Those who received the fasciectomy had fewer recurrence of flexion contractures. The authors concluded that the TEC device should be considered as a preparatory step to pathologic fascia excision during finger extension and not a Dupuytren's contracture treatment.

In 1997, Citron and Messina reported the results from 13 patients (18 fingers) who received treatment with either the TEC or Verona devices for severe Dupuytren's disease [3]. The device was worn from 1 to 4 weeks followed by a fasciectomy and splinting. At a mean follow-up of 18 months, considerable improvements were noted in total extension deficit, total range of active motion, and PIP joint extension deficit. Although improvements were found, the results were worse and recurrence was more of a problem than what was reported in their previous findings (1993 results). They speculated that too rapid an application of traction may have caused the decline in clinical results. The authors also indicate that in the future, they intend to perform skin grafting as soon as the maximal range of movement is obtained. Attempts to use both the TEC and "S" Quattro devices postoperatively were reported to result in a high incidence of complications [3, 4].

In 2001, Barrie and Bishop reported results from 8 patients (9 fingers) who received preoperative treatment with the TEC for either trauma, post traumatic juvenile rheumatoid arthritis, or Dupuytren's disease [5]. Following treatment with the device for an average of 21 days, a mean increase in finger extension of 69° was reported. Mean active ROM increased from 17° to 66°. Following removal of the device, either PIP fusion, PIP arthroplasty, or subtotal fasciectomy were performed.

Clinical results from the use of the other devices, Pipster [6], JESS [7], and Multiplaner Distracter [8], all have indicated varying degrees of success in restoring finger extension. The Pipster was used preoperatively for 10 days to 4 weeks on 5 patients with Dupuytren's disease, followed by fasciectomy. This device performed well as a means of preoperative restoration on joint extension prior to surgery. The JESS device, used for restoration of PIP joint contractures in patients with leprosy, was reported to achieve better results than other more conventional methods used. The Multiplaner Distracter was actually a device designed for distraction of the mandible that

was used on a single patient with a PIP joint contracture following replantation. The initial contracture of 95° was reduced by 5° per day until the digit was extended to 20° of flexion. The device was worn a total of 6 weeks. Six months after removal, 10° of extension had been lost.

The effect of a continuous external force on the palmar fascia of patients with Dupuytren's disease also was examined [9, 10, 11]. Biochemical, morphological, and quantitative analyses were performed on tissue samples removed from patients treated with the TEC device prior to surgery. After continuous elongation with the TEC device, the morphology of the palmar fascia was notably changed in comparison with the non-extended tissue. The collagen fibers and their fibrils, the oxytalan-like microfibrils together with the cells and their cytoskeletal components were all oriented parallel to the stretching force of the device [9].

Bailey et. al. [10] believe that stretching of the contracted tissue occurs with the TEC device. The ability to stretch these tissues and the gradual reduction in resistance to the applied tension suggests a change in the properties of the collagen. The resistance to stretch of collagen is dependent on the formation of intermolecular cross-links between the collagen molecules in the fiber. They found that an increase in enzyme activity degraded the cross-links and thereby weakened the collagen. This was evidenced by an increase in newly synthesized collagen. The increase in tensile force from the TEC device was believed to be responsible for this response which softened the tissue and allowed it to stretch. Tarlton et. al. [11] confirmed external force as the cause for weakened collagen fibers rather than an inflammatory response.

Brandes et. al. [12] examined the microfilament system in vascular endothelium that was removed from palmar fascia that was either unaffected, had Dupuytren's disease, or had Dupuytren's disease and had worn the TEC device for 3 weeks prior to surgery. They concluded that both the presence of stress fibers and the extent of adherens junctions and focal contacts in the endothelial cells correlated with the extending forces inside the palmar fascia. They suggested that the stress applied from the external force changes the cell shape, the orientation of the cytoskeleton in the myofibroblasts and the composition and arrangement of the surrounding extracellular matrix, which was degraded and newly synthesized by these cells. Stress fibers were thought to protect cells from increased mechanical stress and connect them tightly to the subendothelial matrix.

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