The Use of Acellular Dermal Matrix in Dupuytren Disease

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41.1 Introduction

Dupuytren Disease is a progressive condition that involves abnormal thickening and contraction of the palmar fascia. There is a wide spectrum of clinical presentation. The symptomatic aspect of the disease ranges from isolated palmar pits and nodules to disabling flexion contractures of the metacarpophalangeal and interphalangeal joints.

Surgery has been the traditional mainstay of treatment for symptomatic Dupuytren Disease since the 1800s. Surgical treatment options include fasciotomy (Dupuytren 1834; Luck 1959), fasciectomy (Hamlin 1952), and dermofasciectomy (Hueston 1984). These open surgical procedures are effective in treating disease contracture in the short term. However, disease recurrence has remained a significant problem following surgical treatment. One recent study reported a 39 % recurrence rate following fasciectomy and a 62 % recurrence rate following fasciotomy at a median follow-up of 4 years following surgery (Crean et al. 2011).

Percutaneous treatment options are also utilized to treat Dupuytren Disease. These include percutaneous needle fasciotomy, which involves using a needle to puncture and weaken diseased cords (Rowley et al. 1984). The advantage of this approach is that it is minimally invasive and can be performed in the clinical setting. A more recently developed technique is the enzymatic fasciotomy, which involves injection of collagenase to weaken cords (Watt et al. 2010). While these are attractive alternatives to surgery for the treatment of Dupuytren Disease, these methods are also associated with high recurrence rates following treatment (van Rijssen et al. 2012; Peimer et al. 2013).

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P.M.N. Werker et al. (eds.), *Dupuytren Disease and Related Diseases – The Cutting Edge*,
DOI 10.1007/978-3-319-32199-8_41

Dermofasciectomy was advocated for the treatment of Dupuytren Disease by Hueston in 1962 (Hueston 1962). This surgical approach involves excision of overlying skin in addition to excision of diseased fascia, followed by the placement of a full-thickness skin graft to the resulting wound bed. He noted that none of these patients had a disease recurrence. Several case series have since corroborated Hueston's observation that recurrence rarely occurs below a skin graft (Heuston 1969; Tonkin et al. 1984; Logan et al. 1985; Ketchum and Hixson 1987; Kelly et al. 1992; Searle and Logan 1992; Brotherston et al. 1994; Hall et al. 1997; Armstrong et al. 2000; Abe et al. 2007). The mechanism underlying decreased recurrence in the setting of dermofasciectomy is poorly understood. One hypothesis is that full-thickness skin grafts are able to decrease activity of myofibroblasts, as suggested by Rudolph (Rudolph 1979). Despite the favorable long-term outcomes associated with dermofasciectomy, it remains an infrequently performed procedure given its significant surgical morbidity.

Given the success of full-thickness skin grafting, we proposed that the use of acellular dermal matrix in the setting of open fasciectomy for Dupuytren Disease could potentially reduce disease recurrence. Our hypothesis is borne out of basic science experiments demonstrating in a primate model that the placement of a sheet of acellular dermal matrix adjacent to an implant minimizes capsule formation and significantly decreases the presence of myofibroblasts compared to controls without acellular dermal matrix (Stump et al. 2009).

41.2 Materials and Methods

We performed a retrospective cohort study of 43 patients undergoing open fasciectomy for Dupuytren Disease from 2005 to 2012. All procedures were performed by a single surgeon (D.N.) at hospitals affiliated with Yale University School of Medicine. Inclusion criteria included patients with symptomatic Dupuytren Disease and presence of nodules and/or contractures (Fig. 41.1). The fasciectomies were performed in a standard fashion via Bruner incisions in all patients. Our intervention involved the placement of a sheet of acellular dermal matrix (Alloderm, LifeCell, Bridgewater, NJ) in the wound bed following the fasciectomy, placed just prior to skin closure. The sheet of acellular dermal matrix was cut to fit the size of the wound bed (Fig. 41.2) and subsequently sutured in with interrupted absorbable sutures. Sequential patients presenting between the years of 2005 and 2007 were included in the control group. Patients presenting between 2008 and 2012 had acellular dermal matrix placed following standard fasciectomy. All patients were evaluated at period follow-up visits in clinic. Disease recurrence was assessed at follow-up. Recurrence was defined as the presence of Dupuytren tissue in an area that was previously

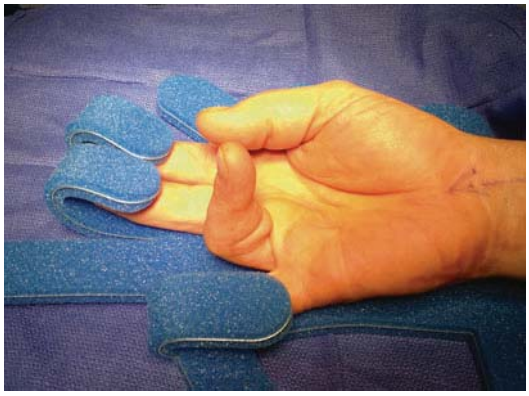

Fig. 41.1 Patient with symptomatic Dupuytren Disease, preoperative

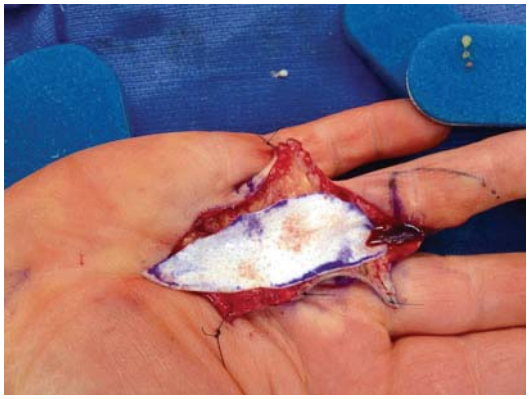

Fig. 41.2 Intraoperative placement of a sheet of acellular dermal matrix in wound bed following standard fasciectomy in the same patient from Fig. 41.1; postoperatively, the finger was completely straightened

operated on, with a contracture greater than that was recorded immediately following the initial surgical procedure.

Patient demographic information was collected for all patients. Additionally, severity of disease, recurrence of disease, wound complications, and other medical comorbidities were recorded. Bivariate analyses were performed using χ^2 analysis using IBM SPSS Statistics version 19.0.0 (IBM, Armonk, NY).

41.3 Results

Our study included 23 patients in the group treated with acellular dermal matrix at the time of open fasciectomy as well as 20 patients in the control group treated only with standard fasciectomy. The median age of the entire patient cohort was 66.5 years (range 54 to 91). There were no statistically significant differences between the two patient groups in terms of age, length of follow-up, severity of disease on initial presentation, presence of diabetes or prostate cancer, use of beta-blockers or alcohol, and presence of seizure disorder (Table 41.1). The locations of disease were also comparable between these two groups (Table 41.2).

We observed a median follow-up of 1.8 years. During the follow-up period, recurrence of disease was observed in 5 of 20 patients (25.0 %) in the control group. In contrast, recurrence was only noted in 1 of 23 patients (4.3 %) in the group with acellular dermal matrix placed. The difference in recurrence rates between these two groups was statistically significant ($P = 0.045$) (Fig. 41.3).

Table 41.1 Characteristics of control and acellular dermal matrix patient cohorts

Characteristic	Control group ($n = 20$)	Dermal matrix group ($n = 23$)
Median age	66	69
Diabetes	5	4
Prostate cancer	8	8
Beta-blockers	3	7
Significant alcohol history	7	9
History of seizure disorder	1	2

Three patients in each group had minor wound complications following surgery. These wound complications all healed with local wound care. We also noted that, interestingly, two patients in the group with acellular dermal matrix placement were noted to have disease extension beyond the border of the acellular dermal matrix, but had no clinical evident recurrence under the area covered by the acellular dermal matrix.

41.4 Discussion

In this study, we propose a novel modification to the standard open fasciectomy for the treatment of Dupuytren Disease. We demonstrate that

Table 41.2 The distribution of affected areas of the hand is similar between the two groups

Affected part of the hand	Control group	Dermal matrix group
Small finger	11	11
Ring finger	14	15
Middle finger	5	7
Index finger	1	1
Thumb	0	2
Palm	8	9

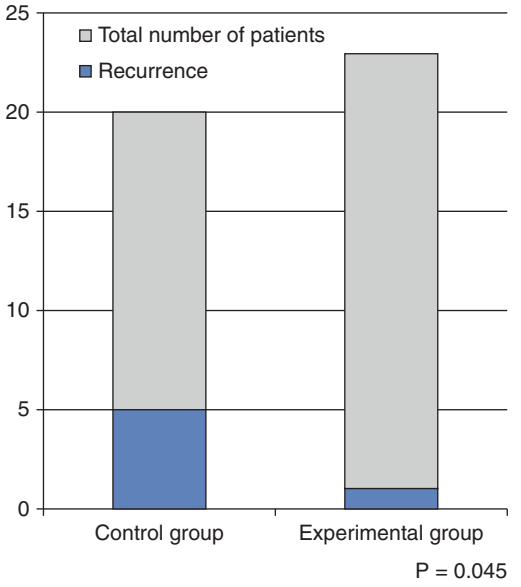

Fig. 41.3 The recurrence of disease was 25 % in the control group compared to 4.3 % in the group with acellular dermal matrix placed

recurrence rates are lower in patients who have a sheet of acellular dermal matrix placed in the wound bed following fasciectomy compared to patients treated with standard fasciectomy for Dupuytren Disease. We observed comparable complication rates between these two groups of patients. Our results have implications for the treatment of Dupuytren Disease.

Currently, no ideal treatment modality exists for Dupuytren Disease. Surgical treatment options such as the standard fasciotomies and fasciectomies are associated with high recurrence rates (Crean et al. 2011). Percutaneous fasciotomies are also associated with high rates of disease recurrence (van Rijssen et al. 2012). Treatment with collagenase injections is also associated with high recurrence rates, with a reported 75 % recurrence rate at eight years following initial injection (Watt et al. 2010). Additionally, up to 100 % of patients receiving collagenase injection for therapy experience at least one treatment-related adverse event, compared to only 21 % of patients undergoing placebo injection (Hurst et al. 2009; Gilpin et al. 2010).

Hueston observed in 1962 that recurrence did not occur in a series of patients undergoing dermofasciectomy for the treatment of Dupuytren Disease (Hueston 1962). In 1969, he reported on a larger series of 65 dermofasciectomy procedures, performed for both primary and recurrent Dupuytren Disease (Heuston 1969). In the follow-up of these patients, he noted that though a few cases of disease extension occurred, there was no recurrence of disease in the areas directly beneath the skin grafts that were placed (Heuston 1969). Since Hueston's studies, several case series have verified his finding of decreased disease recurrence in the setting of dermofasciectomy, with an overall recurrence rate of 4 % from 9 retrospective studies (Tonkin et al. 1984; Logan et al. 1985; Ketchum and Hixson 1987; Kelly et al. 1992; Searle and Logan 1992; Brotherston et al. 1994; Hall et al. 1997; Armstrong et al. 2000; Abe et al. 2007). Despite the effectiveness of dermofasciectomy in treating Dupuytren Disease and in limiting its recurrence, its role in treatment remains limited. The primary reason for this is its significant morbidity secondary to the need for full-thickness skin grafting.

We postulated that the placement of a barrier between the wound bed and the overlying dermis following excision of diseased fascia could recreate the success that Hueston observed in his initial series. The barrier material could theoretically assume the role of a full-thickness skin graft in minimizing subsequent recurrence. We chose to utilize acellular dermal matrix as our barrier material. The rationale behind this selection was based on the increasing popularity of its use in the field of plastic and reconstructive surgery without major complications, reflecting its favorable safety profile. Additionally, histologic studies have demonstrated that its use is associated with decreased proliferation of surrounding myofibroblasts (Stump et al. 2009), which would theoretically be a favorable milieu for patients with Dupuytren Disease, given the central role of myofibroblasts in mediating contracture. We utilized Alloderm, which is an acellular dermal matrix derived from human cadaver skin, treated to remove all cellular and immunogenic components. It retains the structural components of human skin and therefore does not have to be cross-linked, unlike some other dermal matrices, which minimizes unfavorable wound reactions as well as myofibroblast differentiation (van der Veen et al. 2010).

We observed a significantly decreased recurrence rate of 4 % in patients with Alloderm placed in the wound bed following fasciectomy, compared to a recurrence rate of 25 % in patients undergoing the standard fasciectomy. This difference was not attributable to patient-level demographic factors or comorbidities. Interestingly, our 4 % recurrence rate in patients with Alloderm placement identically matches the overall pooled recurrence rate following dermofasciectomy from the retrospective case series. This is a significant finding and has implications for the treatment of Dupuytren Disease, given the ongoing lack of a clear best treatment mechanism. One limitation of our study is our limited sample size. A larger patient cohort would better

elucidate the effect size of the use of Alloderm in reducing disease recurrence. A longer follow-up period would also better demonstrate the effect of our novel intervention.

Conclusions

- Dermofasciectomy is an effective treatment for Dupuytren Disease and is associated with a low recurrence rate of approximately 4 %; however, it is a morbid procedure.
- Patients undergoing open fasciectomy with placement of acellular dermal matrix had dramatically lower recurrence rates compared to patients undergoing open fasciectomy alone (4 % vs. 25 %, $P = 0.045$).

Conflict of Interest Declaration The authors have no disclosures.

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