International Journal of Science and Healthcare Research
DOI: https://doi.org/10.52403/ijshr.20211039
Vol.6; Issue: 4; Oct.-Dec. 2021
Website: ijshr.com
Review Article *ISSN: 2455-7587*

Emerging Concept of Dupuytren's Disease

Putu Feryawan Meregawa[1], John Nolan[2]

[1]Departement of Orthopaedic and Traumatology, Medical Faculty, Udayana University-Sanglah General Hospital Denpasar, Indonesia
[2]Faculty of Medicine, Udayana University, Denpasar

Corresponding Author: Putu Feryawan Meregawa

ABSTRACT

Dupuytren's disease is a disorder of fibroproliferative condition causing thickened and contracted of the palmar fascia. The pathophysiology behind this disease is complex and multifactorial. Some major factors are genetic predisposition, inflammatory response, trauma, comorbidities, and environmental factors. The treatment options for Dupuytren's disease are divided into non-surgical and surgical management. Needle fasciotomy and fasciectomy are some of the most common surgical procedures chosen. Novel non-surgical treatment option as the recent advance in the treatment of the disease is the injection of collagenase Clostridium histolyticum (CCH). One of the pitfalls of Dupuytren's management is the high possibility of the disease's recurrence along with some other post-intervention complications. Rehabilitation following the interventions is needed to manage the maximum range of motion and curtail the inflammatory response after the cord disruption.

Keywords: Dupuytren's disease, clostridium histolyticum, fasciectomy

INTRODUCTION

Dupuytren's disease is a fibroproliferative disease of the hand which may lead to fixed flexion contracture. The condition may also cause a functional disturbance of the affected digits.[1] The disease is explained by a French Surgeon, Baron Guillaume Dupuytren back in 1830s.[2] This condition caused by aberrant accumulation of collagen resulting in the occurrence of palmar aponeurosis thickening and joint contracture. The contracture may affect the joint of the hand including metacarpophalangeal (MCP), proximal interphalangeal (PIP), and also distal interphalangeal joints.[3,4] Fixed flexion contracture of the digits restricts the hand movements and functions.[1,3] Dupuytren's disease affect around 12% of Western population at the age of 55 years old, and rising to 29% among elderly at the age of 75 years old.[5] It is estimated that the predicted prevalence of Dupuytren's disease is around 7,3%. Annual incidence is thought to be around 3 cases per 10.000 adult.[6] A study also showed that the overall prevalence of the high-risk group is 0.2% to 50%.[5,7]

The progression of the disease is varied, it may be initiated with a rigid nodule at the hand which may progressing fibrous collagenous cords expanding through the digits.[1] Later, it may be thickened and contracted resulting in contracture of the digits. It is reported that around 20% to 40% people with Dupuytren disease experienced an impaired hand function.[1,6,8] As the impact of restricted hand movements and functions, the deformity can critically confine daily activity, self-care, employment, and also curtail the quality of life.[1]

The disease may progress badly in several months to years from the onset as it typically develops later in life.[9] Micro rupture of the collagenase fibres including palmar fascia, proliferation and differentiation of fibroblasts of the hand can be trigger by several risk factor such as lifestyle, trauma, or genetic

predisposition.[10,11] The treatment for this disease can be divided into non-surgical and surgical interventions.[3,4] Choice of treatment to date for the late-stage of the disease is varied despite of surgical intervention is still the main option for the disease. Complications and post-treatment should be monitored extensively as post-treatment care is important to prevent complications. However, surgical intervention may not guarantee that there is no risk of recurrence.[3]

New choice of treatment called Collagenase clostridium histolyticum (CCH) is a pharmacological treatment that showing a promising result in the treatment of Dupuytren disease, however there is still no exact definitive pharmacological treatment. In this review.[12] The author will discuss about the overview of Dupuytren disease, including the pathophysiology, etiology, and recent treatment options in treating the disease.

Pathogenesis

A complex combination of environmental factors, genetic predisposition and protein expression.

Genetic

Exact etiology of Dupuytren's disease is remain unknown however, genetic predisposition is accountable in the development of the disease. These are including family linkage, mitochondrial mutation, Wnt signalling pathway, and HLA type mutation. Based on several study, it was stated that the disease is heritable. It is believed that the mode of inheritance is an autosomal dominant with penetrance variable. It is found that the chance for sibling of Dupuytren disease patients develop the same condition is three times higher. There are also some cases that have been reported which associated with identical twins with Dupuytren disease.[7] 90% Dupuytren disease patients among Caucasian showed a mutation 16s rRNA gene within the mitochondria.[13] In Wnt signalling pathway, there are six genes encoded proteins, including *SFPR4*, *RSPO2*, and *WNT4*.[14] Some other fibrotic diseases are also associated with Wnt signalling as it may affect the development of Dupuytren disease.[15] To date, a genome-wide association study (GWAS) showed a significantly tripled risk of acquiring Dupuytren disease. The promotion of myofibroblast proliferation during fibrosis tended to be higher alongside the downregulation of Wnt antagonist, called *SFPR4*.[16,17] These statements may support the linkage between Wnt signalling pathway and the occurrence of Dupuytren disease.[14,16,17]

Changes in immune responses may also play roles in the pathophysiology. Alterations of immune cells resulting in the unbalance level of cytokines and growth factors. These support the fact that a persistent low-grade inflammation may enhance the progression of fibrosis. Diabetes, alcohol consumption, smoking, and aging can increase the oxidative stress which may lead to ischemia and microangiopathy within the fascia of the palm.[18] Ischemia would lead to the production of free radicals along with xanthin oxidase and hypoxanthine. Study showed that increased level of hypoxanthine and xanthin oxidase are found in the palmar fascia of patients with Dupuytren disease.[19] The condition of high free radical level trigger the production of several pro-inflammatory cytokines including, interleukin-6 (IL-6), IL-1, IL-8, tumour necrosis factor (TNF), transforming growth factor-beta (TGF-β), and many other cytokines.[18,20] Other environmental factors and comorbidities that may also accountable as the additional risk factors associated with the disease are trauma, HIV, epilepsy, and cancer.[18]

During the process there are biochemical and histological changes in the tissue resulting in an increased level of extracellular matrix (ECM) protein. Some of the fibroblast of ECM protein are contractile myofibroblast and collagen.[18] In Dupuytren disease, the changes of ECM protein may vary throughout the distinctive phase of the

disease.[21] In fact, normal fascia of the palmar mainly consisted of collagen type I.[18,21] However, the palmar fascia of patients with Dupuytren disease is composed more with collagen type III at the early stage which will be taken over by collagen type I.[10,22] The ECM homeostasis in Dupuytren disease is highly related with some single-nucleotide polymorphisms (SNPs) in GWAS. These are linked with matrix remodelling, such as integrin alpha-11 (ITGA11), matrix metalloprotease 14 (MMP14), and discoid domain receptor (DDR2).[23] The association of these molecules are accountable for developing palmar fibrosis in the disease.

MMP14 is one of MMP proteases family which linked with high-risk locus which may result in Dupuytren nodules overexpression.[24] As an essential fibrotic regulator in Dupuytren disease, the elimination of MMP14 in vitro was proven to inhibit both MMP2 activation and cell contraction.[25] Another gene that had been describe also having a crucial role of fibrosis regulator is DDR2. Based on its properties, DDR2 is a usual regulator of fibrosis in the liver and lung.[26,27] It is described there was a likelihood of DDR2 have the same mechanism regarding the promotion of fibroblast and collagen within the fascia of palmar.[23]

Clinical Symptoms and Diagnosis

It is more common for the disease to occur in males above 40 years old. Multiple or a singular small nodule may occur in the patient's palmar fascia which later could develop to contracture of the finger.[28] The nodules are mostly painless. Early recognition of the disease is important as it may progress to a flexion contracture. Difficulties in doing activities of daily living can be experienced by the patients as the disease may occur bilaterally mostly the fourth digit.[29] Luck describe some stages of the disease progression starting with an early proliferative condition in stage 1. The phase is construed with a band and nodule which thickened in the palmar fascia aponeurosis. The nodule and band may further develop a skin pitting or puckering. In this stage, majority of the tissues are consisted of myofibroblast cells compared to collagen cells. The existence of peritendinous band along with restrictive finger movement defined the stage 2 of the disease. Later in the stage 3, fibrous cord appears following the disappearance of fibroblastic nodules. There is a fusion between skin above and below the nodules and cords, forming a typical flexion contracture which affect the PIP and MCP joints.[18,30] Any risk factor and comorbidities may accelerate the progression from one stage to the other stages.[13]

In the disease progression, it is estimated only around 50% of patients with nodule that further would develop the cords.[31] The fourth finger is the most affected digit in Dupuytren disease followed by the fifth, third, second, and first digit. There is also a term for any Dupuytren tissue outside the palmar fascia, it is called Dupuytren diathesis. Dupuytren diathesis includes formation of Dupuytren tissues in the penis (Peyronie's disease), feet (Ledderhose's disease), and knuckles (Garrod's pad). As these tend to be inherited, family history and Northern European ethnicity are the main characteristics of these disease along with other characteristics such as bilateral and ectopic lesions.[32]

Non-surgical management

To date, there is no definitive cure for Dupuytren disease, as the recent treatment options are focusing on maintaining hand function.[33] Despite the last surgery option in correcting the flexion deformity in this late-stage of disease, there are several non-surgical options inclusive of physical therapy, radiotherapy, and also pharmacological therapy such as steroids and vitamin E. However, there are still only limited descriptions regarding the exact efficacy and evidence about these non-surgical treatments.[34] Recently, non-surgical treatment may also be used in the late-stage

of the disease, the injection Collagenase *Clostridium histolyticum* (CCH). CCH injections may offer more faster recovery and minimal complications compared to surgical procedure. *Clostridium histolyticum* is an enzyme which might lysis collagen cords on the palm.[12,35]

This novel treatment consists of type I and type II collagen combination which may dissolve several collagen types, including collagenases in the Dupuytren disease. The next day after the injection, there will be an extension manipulation to disrupt the cords.[22] Phase III study of CCH found that it is safe and effective towards the disease. Adverse events found in two trials. Most adverse events related with the procedure causing peripheral edema, contusion in the site of injection, swelling in the injection extremity.[36] The worst adverse events found as it was causing tendon rupture and complex regional pain syndrome (CRPS). [36,37]

Other treatment options such as intramodular injection and steroid therapy, unable to show a promising result and also developing a depigmentation or subcutaneous atrophy.[38] The newest drug that is still studied heavily is an anti-tumour necrosis factor therapy which may inhibit the TNF that occurred via Wnt signalling pathway.[20]

Surgical management

During the late stage of the disease, surgical and few operative options are the mainstay of the treatment. Some operative procedures are dermofasciectomy, needle fasciotomy, and limited fasciectomy. These procedures have their own benefits and limitations.[39,40] The more invasive the surgery, the more successful the procedure to supress the recurrence rate of the disease despite the longer duration of post-surgery recovery. One of the less invasive technique is percutaneous needle fasciotomy which using a hypodermic needle to disrupt the cords. This procedure can be done in outpatient setting and have a recurrence rate of 30% post-surgical compared to only 6% in limited fasciectomy procedure. Compared to CCH injection, needle fasciotomy showed a promising result in spite of the higher risk of recurrence rate.[39,41]

Local fasciectomy is done by removing the afflicted fascia over single or more incisions. Compared to other options, this limited fasciectomy has been a good option as it provides quick functional recovery and less invasive procedure. Despite the benefit, this procedure still has a high recurrence rate and early post-operative contracture.[42] One of the abandoned operative procedures is radical fasciectomy which is done by the removal of both healthy and afflicted tissue. However, by removing the healthy and afflicted fascia may cause a recurrence of the disease. The most commonly procedure performed is limited fasciectomy which dissects the afflicted tissue longitudinally. The procedure consists of separating the fascia and the fat, the fascia then will be removed from proximal to distal of the hand. This technique usually removes only the afflicted tissue as the fascia next to the cord is separate. Similar to limited fasciectomy, dermofasciectomy also has the overlying contracting skin to be removed and then cover it with a skin graft.[42]

Outcome of Dupuytren's disease

Hand function is the standard measurement regarding the disease's therapy. It found the motion recovery was reported by most of patients. There are some considerations towards the outcome. Based on the literature, the complication rates following a surgical option vary from with the average of 15% patients. The most usual complications occur are complications during the wound healing and pain. Other complications may also occur, including digital artery and nerve injury, complex regional pain syndrome, and infections. However, data shows that the complication rates raise following the correction of the deformity >60°.[3]

The possibility of recurrence of Dupuytren disease should be delivered

completely to the patients as the disease's recurrence rate is high. A 12 years follow-up study showed a recurrence rate of 47% along with 74% having some types of recurrence.[44] There are also some things need to be carefully considered following the surgery. Up to now, it is essential to administer a post-operative rehabilitation programme. The rehabilitation programme is useful to prevent future flexion contracture and maintain the flexibility of the hand. Before starting the therapy, few days of immobilization with splinting is needed following the surgery. Some focuses during the post-operative therapy are utilizing ROM, focusing on wound healing, and managing scar tissue. There are several splinting techniques that can be used which concentrating on continuous extension force on the afflicted digits. Both static and dynamic splinting techniques can be used during different period, as dynamic splint during the day while static during the night. To maximize the ROM, the exercise should be done up to 1 year after the surgery, while weight exercise should be started 4 weeks following the surgery.[45]

The success measurements towards the surgery are often bias as it may failed to fill patient's perspective. In such cases, the emersion of chronic regional pain syndrome or cold intolerance despite the success in correcting the angular deformity.[43] To overpass the gap, it is important to provide patients with patient-reported outcomes measures (PROMs).[46] One of the most common PROM used is disease-specific instruments such as the Unité Rhumatologique des Affections de la Main (URAM) and Disabilities of the Arm, Shoulder and Hand (DASH).[47] The aim of these scales is to provide a thorough assessment of the impact on patients' quality of life, including recreational activities and daily tasks.[48]

CONCLUSION

Dupuytren's disease is a fibroproliferative condition that may drastically affect the hand function. A complex combination between environmental factor, genetic predisposition, and comorbidities thought to be the triggering factor. Both surgical and non-surgical treatment might be the management based on the severity level of the contracture. However, none of the treatment may guarantee no recurrence of the disease. Physical therapy should be done following the operative procedure.

Approaching Dupuytren's disease in the future

Even though, this disease originated 2.500 years ago, we are just at the start to knowing the exact pathogenesis. As there are more minimally invasive technique to be done in the office setting, it is important to determine and identify Dupuytren's disease in the early stages. The consensus later in several years may also be needed to provide physician with a better choice of treatment regarding its clinical efficacy and minimal recurrence later following the intervention. Standardized outcome and recurrence reports are needed to be collected as it may allow patients and physicians to compare all of the interventions. Further large studies scale is needed to be conducted towards the successful treatment and recurrence rate for each intervention. Furthermore, future novel therapy in several pathway, Wnt and TNF may also be developed as they may helped concentrating on the pathogenesis of the disease.

Acknowledgement: None

Conflict of Interest: None

Source of Funding: None

REFERENCES

1. Wilburn J, McKenna SP, Perry-Hinsley D, Bayat A. The impact of Dupuytren's disease on patient activity and quality of life. The Journal of hand surgery. 2013 Jun 1;38(6):1209-14.
2. Elliot D. The early history of Dupuytren's disease. Hand clinics. 1999 Feb;15(1):1.

3. Denkler K. Surgical complications associated with fasciectomy for dupuytren's disease: a 20-year review of the English literature. Eplasty. 2010;10.
4. Chen NC, Srinivasan RC, Shauver MJ, Chung KC. A systematic review of outcomes of fasciotomy, aponeurotomy, and collagenase treatments for Dupuytren's contracture. Hand. 2011 Sep 1;6(3):250-5.
5. Lanting R, Broekstra DC, Werker PM, van den Heuvel ER. A systematic review and meta-analysis on the prevalence of Dupuytren disease in the general population of Western countries. Plastic and reconstructive surgery. 2014 Mar 1;133(3):593-603.
6. DiBenedetti DB, Nguyen D, Zografos L, Ziemiecki R, Zhou X. Prevalence, incidence, and treatments of Dupuytren's disease in the United States: results from a population-based study. Hand. 2011 Jun 1;6(2):149-58.
7. Hindocha S, McGrouther DA, Bayat A. Epidemiological evaluation of Dupuytren's disease incidence and prevalence rates in relation to etiology. Hand. 2009 Sep 1;4(3):256-69.
8. Degreef I, De Smet L. A high prevalence of Dupuytren's disease in Flanders. Acta Orthopædica Belgica. 2010 Jun 1;76(3):316.
9. Townley WA, Baker R, Sheppard N, Grobbelaar AO. Dupuytren's contracture unfolded. Bmj. 2006 Feb 16;332(7538):397-400.
10. Al-Qattan MM. Factors in the pathogenesis of Dupuytren's contracture. The Journal of hand surgery. 2006 Nov 1;31(9):1527-34.
11. Lucas G, Brichet A, Roquelaure Y, Leclerc A, Descatha A. Dupuytren's disease: personal factors and occupational exposure. American journal of industrial medicine. 2008 Jan;51(1):9-15.
12. Gilpin D, Coleman S, Hall S, Houston A, Karrasch J, Jones N. Injectable collagenase Clostridium histolyticum: a new nonsurgical treatment for Dupuytren's disease. The Journal of hand surgery. 2010 Dec 1;35(12):2027-38.
13. Bayat A, Walter J, Lambe H, Watson JS, Stanley JK, Marino M, Ferguson MW, Ollier WE. Identification of a novel mitochondrial mutation in Dupuytren's disease using multiplex DHPLC. Plastic and reconstructive surgery. 2005 Jan 1;115(1):134-41.
14. Dolmans GH, Werker PM, Hennies HC, Furniss D, Festen EA, Franke L, Becker K, van der Vlies P, Wolffenbuttel BH, Tinschert S, Toliat MR. Wnt signaling and Dupuytren's disease. New England Journal of Medicine. 2011 Jul 28;365(4):307-17.
15. Lam AP, Gottardi CJ. β-catenin signaling: a novel mediator of fibrosis and potential therapeutic target. Current opinion in rheumatology. 2011 Nov;23(6):562.
16. Matsushima K, Suyama T, Takenaka C, Nishishita N, Ikeda K, Ikada Y, Sawa Y, Jakt LM, Mori H, Kawamata S. Secreted frizzled related protein 4 reduces fibrosis scar size and ameliorates cardiac function after ischemic injury. Tissue Engineering Part A. 2010 Nov 1;16(11):3329-41.
17. Surendran K, Schiavi S, Hruska KA. Wnt-dependent β-catenin signaling is activated after unilateral ureteral obstruction, and recombinant secreted frizzled-related protein 4 alters the progression of renal fibrosis. Journal of the American Society of Nephrology. 2005 Aug 1;16(8):2373-84.
18. Shih B, Bayat A. Scientific understanding and clinical management of Dupuytren disease. Nature Reviews Rheumatology. 2010 Dec;6(12):715.
19. Murrell GA, Francis MJ, Bromley L. Free radicals and Dupuytren's contracture. Br Med J (Clin Res Ed). 1987 Nov 28;295(6610):1373-5.
20. Verjee LS, Verhoekx JS, Chan JK, Krausgruber T, Nicolaidou V, Izadi D, Davidson D, Feldmann M, Midwood KS, Nanchahal J. Unraveling the signaling pathways promoting fibrosis in Dupuytren's disease reveals TNF as a therapeutic target. Proceedings of the National Academy of Sciences. 2013 Mar 5;110(10):E928-37.
21. Satish L, LaFramboise WA, O'Gorman DB, Johnson S, Janto B, Gan BS, Baratz ME, Hu FZ, Post JC, Ehrlich GD, Kathju S. Identification of differentially expressed genes in fibroblasts derived from patients with Dupuytren's Contracture. BMC medical genomics. 2008 Dec 1;1(1):10.
22. Watt AJ, Hentz VR. Collagenase clostridium histolyticum: a novel nonoperative treatment for Dupuytren's disease. International Journal of Clinical Rheumatology. 2011 Apr 1;6(2):123.
23. Ng M, Thakkar D, Southam L, Werker P, Ophoff R, Becker K, Nothnagel M, Franke A, Nürnberg P, Espirito-Santo AI, Izadi D.

A genome-wide association study of Dupuytren disease reveals 17 additional variants implicated in fibrosis. The American Journal of Human Genetics. 2017 Sep 7;101(3):417-27.
24. Hutchinson JW, Tierney GM, Parsons SL, Davis TR. Dupuytren's disease and frozen shoulder induced by treatment with a matrix metalloproteinase inhibitor. The Journal of bone and joint surgery. British volume. 1998 Sep;80(5):907-8.
25. Wilkinson JM, Davidson RK, Swingler TE, Jones ER, Corps AN, Johnston P, Riley GP, Chojnowski AJ, Clark IM. MMP-14 and MMP-2 are key metalloproteases in Dupuytren's disease fibroblast-mediated contraction. Biochimica et Biophysica Acta (BBA)-Molecular Basis of Disease. 2012 Jun 1;1822(6):897-905.
26. Olaso E, Ikeda K, Eng FJ, Xu L, Wang LH, Lin HC, Friedman SL. DDR2 receptor promotes MMP-2–mediated proliferation and invasion by hepatic stellate cells. The Journal of clinical investigation. 2001 Nov 1;108(9):1369-78.
27. Zhao H, Bian H, Bu X, Zhang S, Zhang P, Yu J, Lai X, Li D, Zhu C, Yao L, Su J. Targeting of discoidin domain receptor 2 (DDR2) prevents myofibroblast activation and neovessel formation during pulmonary fibrosis. Molecular Therapy. 2016 Oct 1;24(10):1734-44.
28. Anthony SG, Lozano-Calderon SA, Simmons BP, Jupiter JB. Gender ratio of Dupuytren's disease in the modern US population. Hand. 2008 Jun;3(2):87-90.
29. DiBenedetti DB, Nguyen D, Zografos L, Ziemiecki R, Zhou X. Prevalence, incidence, and treatments of Dupuytren's disease in the United States: results from a population-based study. Hand. 2011 Jun 1;6(2):149-58.
30. Luck JV. Dupuytren's contracture: a new concept of the pathogenesis correlated with surgical management. JBJS. 1959 Jun 1;41(4):635-64.
31. Reilly RM, Stern PJ, Goldfarb CA. A retrospective review of the management of Dupuytren's nodules. The Journal of hand surgery. 2005 Sep 1;30(5):1014-8.
32. Hindocha S, Stanley JK, Watson S, Bayat A. Dupuytren's diathesis revisited: evaluation of prognostic indicators for risk of disease recurrence. The Journal of hand surgery. 2006 Dec 1;31(10):1626-34.
33. Balaguer T, David S, Ihrai T, Cardot N, Daideri G, Lebreton E. Histological staging and Dupuytren's disease recurrence or extension after surgical treatment: a retrospective study of 124 patients. Journal of Hand Surgery (European Volume). 2009 Aug;34(4):493-6.
34. Ball C, Izadi D, Verjee LS, Chan J, Nanchahal J. Systematic review of non-surgical treatments for early dupuytren's disease. BMC musculoskeletal disorders. 2016 Dec;17(1):1-7.
35. Badalamente MA, Hurst LC, Hentz VR. Collagen as a clinical target: nonoperative treatment of Dupuytren's disease. The Journal of hand surgery. 2002 Sep 1;27(5):788-98.
36. Peimer CA, Wilbrand S, Gerber RA, Chapman D, Szczypa PP. Safety and tolerability of collagenase Clostridium histolyticum and fasciectomy for Dupuytren's contracture. Journal of Hand Surgery (European Volume). 2015 Feb; 40(2):141-9.
37. Zhang AY, Curtin CM, Hentz VR. Flexor tendon rupture after collagenase injection for Dupuytren contracture: case report. The Journal of hand surgery. 2011 Aug 1;36(8):1323-5.
38. Costas B, Coleman S, Kaufman G, James R, Cohen B, Gaston RG. Efficacy and safety of collagenase clostridium histolyticum for Dupuytren disease nodules: a randomized controlled trial. BMC musculoskeletal disorders. 2017 Dec;18(1):1-0.
39. Armstrong JR, Hurren JS, Logan AM. Dermofasciectomy in the management of Dupuytren's disease. The Journal of bone and joint surgery. British volume. 2000 Jan;82(1):90-4.
40. Kan HJ, Verrijp FW, Hovius SE, van Nieuwenhoven CA, Dupuytren Delphi Group, Selles RW. Recurrence of Dupuytren's contracture: a consensus-based definition. PloS one. 2017 May 15;12(5):e0164849.
41. Van Rijssen AL, Ter Linden H, Werker PM. Five-year results of a randomized clinical trial on treatment in Dupuytren's disease: percutaneous needle fasciotomy versus limited fasciectomy. Plastic and reconstructive surgery. 2012 Feb 1;129(2):469-77.
42. McGrouther DA: Dupuytren's contracture, in Green DP, Hotchkiss RN, Pederson WC,

Wolfe SW, eds: Operative Hand Surgery, ed 5. New York, NY, Churchill Livingstone, 2005, vol 1, pp 159-186
43. Wormald JC, Rodrigues JN. Outcome measurement in plastic surgery. Journal of Plastic, Reconstructive & Aesthetic Surgery. 2018 Mar 1;71(3):283-9.
44. Vigroux JP, Valentin P. A natural history of Dupuytren's contracture treated by surgical fasciectomy: the influence of diathesis (76 hands reviewed at more than 10 years). InAnnales de chirurgie de la main et du membre supérieur 1992 Jan 1 (Vol. 11, No. 5, pp. 367-374). Elsevier Masson.
45. Larson D, Jerosch-Herold C. Clinical effectiveness of post-operative splinting after surgical release of Dupuytren's contracture: a systematic review. BMC musculoskeletal disorders. 2008 Dec;9(1):1-7.
46. Hudak PL, Amadio PC. Bombardier C. The Upper Extremity Collaborative Group (UECG). Development of an upper extremity outcome measure: the DASH (Disabilities of the Arm, Shoulder and Hand)[corrected]. Am J Ind Med. 1996; 29(06):602-8.
47. Ball C, Pratt AL, Nanchahal J. Optimal functional outcome measures for assessing treatment for Dupuytren's disease: a systematic review and recommendations for future practice. BMC musculoskeletal disorders. 2013 Dec;14(1):1-1.
48. Rodrigues JN, Zhang W, Scammell BE, Davidson D, Fullilove S, Chakrabarti I, Russell PG, Davis TR. Recovery, responsiveness and interpretability of patient-reported outcome measures after surgery for Dupuytren's disease. Journal of Hand Surgery (European Volume). 2017 Mar;42(3):301-9.

How to cite this article: Meregawa PF, Nolan J. Emerging concept of Dupuytren's disease. *International Journal of Science & Healthcare Research.* 2021; 6(4): 278-285. DOI: *https://doi.org/10.52403/ijshr.20211039*

******