Role of Platelets Rich Plasma (PRP) on the Outcome of Zone II Flexor Tendon Repair and Proximal Interphalangeal Joint (PIPJ) Range of Motion

Thesis

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بسم الله الرحمن الرحيم

قالوا

سبحانك لا علم لنا إلا ما علمتنا إنك أنت العليم الحكيم

صدق الله العظيم

سورة البقرة الآية: ٣٢

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List of Contents

Title	Page No.

List of Tables

Table No.	Title	Page No.

List of Figures

Fig. No.	Title	Page No.

List of Figures Cont…

Fig. No.	Title	Page No.

List of Abbreviations

Abb.	Full term
ACD	Acid citrate dextrose
ADSCs	Adipose derived stem cells
AP	Anteroposterior
bFGF	Basic fibroblast growth factor
bMP	Bone morphogenetic proteins
BMSCs	Bone marrow stem cells
DIP	Distal interphalangeal
DIPJ	Distal interphalangeal joint
ECM	Extra-cellular matrix
EGF	Endothelial growth factor
ERK	Extracellular-regulated kinase
FAK	Focal adhesion kinase
FDP	Flexor Digitorum Profundus
FDS	Flexor Digitorum Superficialis
FPL	Flexor pollicis longus
HGF	Hepatocyte growth factor
IGF-1	Insulin like growth factor
ILGF	Insulin like growth factor
IP	Interphalangeal
L-PRF	Leucocyte- and platelet-rich fibrin
L-PRP	Leucocyte- and PRP
MCP	Metacarpophalangeal
MCPJ	Metacarpal phalangeal joint
PDGF	Platelet-derived growth factor
PIP	Proximal interphalangeal
PIPJ	Proximal interphalangeal joint

List of Abbreviations Cont…

Abb.	Full term
P-PRF	Pure platelet-rich fibrin
P-PRP	Pure Platelet-Rich Plasma
PRP	Platelet-rich plasma
ROM	Range of motion
SCX	Scleraxis
TGF	Transforming growth factor
TSCs	Tendon stem/progenitor cells
VEGF	Vascular endothelial growth factor
WBCs	White blood cells

INTRODUCTION

Zone II flexor tendon repair remains a surgical challenge due to the complex anatomy in the region. In this zone, both the flexor digitorum profundus and flexor digitorum superficialis must glide within a synovial sheath through a series of fibro-osseous pulleys. Normal motion of the proximal interphalangeal joint requires bony support, intact articular surfaces, unimpeded tendon gliding, and uncompromised integrity of the collateral ligaments and volar plate. Deficiency in one of these structural requirements can lead to loss of finger joint motion and decreased hand function. Obstacle in gliding, including scar formation or excess surgical knots can negatively affect a patient’s postoperative function. Early active and passive motion has been shown to improve healing and reduce adhesions ***(Hatanaka et al., 2000; Boyer et al., 2001; Chesney et al., 2011).***

However, overly strenuous early mobility puts the repair at risk of rupture, which usually occurs within the first 3 weeks ***(Nunley, 2006; Thomopoulos et al., 2010).***

The published causes of failure of the repair including postoperative adhesions and stiffness among other complications are still a concern. They will continue to pose a challenge for scientists performing research into the mechanics and biology of flexor tendon repairs, especially in zone II.

Platelet-rich plasma (PRP) contains many of the growth factors thought to be important in tendon healing, including PDGF, IGF-1, TGF-β, VEGF, bFGF, and EGF ***(Hsu and Chang, 2004; Alsousou et al., 2009).***

PRP is appealing for clinical application as an inexpensive source of growth factors. Being autologous, there is no concern for immunologic response. PRP is already widely used in orthopedics for treatment of musculoskeletal injuries and is sought to decrease inflammation of the tendons and hence decrease the risk of adhesions ***(Alsousou et al., 2009).***

Clinical applications for PRP include rotator cuff repair, Achilles tendon repair, Achilles tendinopathy, and lateral epicondylitis; however, the efficacy of PRP is controversial ***(Barber et al., 2011; Chahal et al., 2012).***

AIM OF THE WORK

The Aim is to study the effect of combination of PRP injection with physiotherapy on gliding and range of motion improvement after flexor tendon zone II injury.

Chapter 1

ANATOMY OF THE FLEXOR TENDONS

The flexor tendon system of the hand consists of the long flexor muscles originating from the forearm, their tendinous extensions, and the specialized digital flexor sheaths. These components work in harmony to produce smooth and efficient flexion of the digits of the hand ***(De Maeseneer et al., 2015).***

Fingers flexors:

The long flexor tendons of the fingers involve the Flexor Digitorum Superficialis **(FDS)**, Flexor Digitorum Profundus **(FDP)** and Flexor pollicis longus **(FPL).**After exiting from the carpal tunnel and passing deep to the neurovascular structures in the proximal palm, the FDP tendon lies deep to the FDS tendon for each finger and each continues toward the fibrous flexor sheath for its respective finger. The FPL tendon exit from the carpal tunnel and runs through the thenar musculature toward its own fibrous flexor sheath, inserting into the base of the distal phalanx ***(Torrie et al., 2010)*****.**

As the FDS enters the fibrous flexor sheath on the palmer aspect of the proximal phalanx, it splits encircling the FDP tendon and re- joins deep to it forming the Camper's chiasm **(Figure 1)** then inserts by separate slips into the middle phalanx. The FDP tendon runs through the fibrous flexor sheath initially deep to the FDS, then superficial distal to Camper's chiasm and finally as the single tendon distal to the FDS insertion to be inserted into the base of the distal phalanx ***(Goggins et al., 2014).***

Cadaveric studies in Japan estimate that it is totally absent in 2% of individuals ***(Stein et al., 1990)***, and a similar result of 2% was also reported in a clinical trial in Ireland by Thompson in 2002.

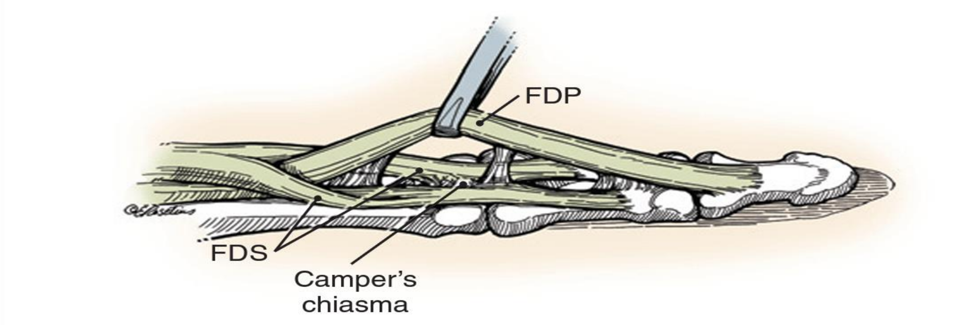

Figure (1): The relation between FDP and FDS ***(Lippincott Williams and Wilkins, 2011)***.

Flexor pulley system:

The flexor tendon pulleys are fibrous tissue condensations, which almost encircle the flexor tendons forming a fibro- osseous channel that functions to keep the tendons adjacent to the phalanges.

The function of the annular pulley is to allow smooth gliding of the tendon and prevent bowstringing, while the cruciate pulleys prevent sheath collapse and expansion during digital motion. It facilitates approximation of annular pulley during flexion (figure 2).

Five annular and three cruciate pulleys have been identified in each of the fingers. The first annular pulley (A1) is at the level of the metacarpal phalangeal joint (MCPJ). The majority of the fibers (2/3) arise from the palmar plate; the remainder (1/3) arises from the proximal portion of the proximal phalanx.

The second annular pulley (A2) is located over the proximal portion of the proximal phalanx, and the third (A3) is at the level of the proximal interphalangeal joint (PIPJ) and attaches to its palmar plate.

The first cruciate pulley (C1) is located between A2 and A3 over the distal portion of the proximal phalanx.

The fourth annular pulley (A4) is at the midportion of the middle phalanx. The second cruciate pulley (C2) is between A3 and A4, overlying the proximal portion of the middle phalanx.

The fifth annular pulley (A5) is located over the distal interphalangeal joint (DIPJ) and is attached to its palmar plate. The third cruciate pulley (C3) is located between A4 and A5 at the distal end of the middle phalanx ***(Doyle, 1988; Doyle, 1989; Doyle, 2001).***