Contents

Subjects	Page
List of abbreviations List of figures List of tables	V
• Introduction	1
Aim of the Work	4
• Review of Literature	
◆ Chapter (1): Functional Anatomy of the Fo	oot5
◆ Chapter (2): Rheumatoid Arthritis and Foo	ot38
◆ Chapter (3): Assessment of Foot Pain in Rheumatoid Arthritis Patients	59
◆ Chapter (4): Management of Foot Pain in Rheumatoid Arthritis Patients	94
Patients and Methods	113
• Results	136
• Discussion	174
Summary and Conclusion	189
• Recommendations	193
• References	194
• Appendices	226
Arabic Summary	

List of Abbreviations

ACPA	Anti citrullinated peptide antibody
ACR	American College of Rheumatology
ADAMTS5	Aggrecanase
ALP	Alkaline phosphatase
ALT	Alanine aminotransferase
AST	aspartate aminotransferase
BMI	body mass index
СВС	Complete blood count
CRP	C reactive protein
CT	Computerized tomography
DAS	Disease activity score
DD	Disease duration
DIP	Distal interphalangeal
DMARDs	Disease-modifying anti-rheumatic drugs
DPPP	dynamic peak plantar pressure
DVT	Deep vein thrombosis
ELISA	Enzyme-linked immunosorbent assay
ESR	Erythrocyte sedimentation rate
EULAR	European League Against Rheumatism
EVA	ethylene vinyl acetate
FFI	Foot function index
FO	Foot orthoses
FP	Frontal plane
GS	Gray scale
GSUS	gray scale ultrasound
IFN	

IL	Interleukin
IP	Interphalangeal
IPK	Intractable Plantar Keratotic
JE	joint erosion
JES	Joint Erosion Score
JSN	Joint Space Narrowing
kpa	kilopascal
LLLT	Low-level laser therapy
MCP	Metacarpophalangeal
MDA	Minimal disease activity
МНС	Major histocompatibility complex
MHz	Megahertz
MMP	matrix metalloproteinases
MRI	Magnetic resonance imagining
MSUS	Musculoskeletal ultrasound
MT	Metatarsal
MTC	metatarsal cuneiform joint
MTP	Metatarsophalangeal
MTX	Methotrexate
NSAIDs	non-steroidal anti-inflammatory drugs
OA	Osteoarthritis
OMERACT	Outcome Measures in Rheumatology
PD	Power Doppler
PDUS	Power Doppler ultrasound
PF	physical functioning
PGE	prostaglandin
PIP	Proximal interphalangeal
POP	Plaster Of Paris

List of Abbreviations

PPA	plantar pressure assessment
RA	Rheumatoid arthritis
RANKL	RANK ligand
RF	Rheumatoid factor
ROM	Range of joint motion
SD	Standard deviation
SENS	Simple Erosion Narrowing Score
SP	Sagittal plane
SPPP	static peak plantar pressures
TCI	total contact insoles
TENS	Transcutaneous electrical nerve stimulation
TNF	Tumor necrosis factor
TP	Transverse plane
VAS	visual analog scale

_

List of Figures

No.	<u>Figure</u>	Page
1	(a)Longitudinal and transverse arches are formed by the bones of the foot. (b) the 26 bones of the foot are divided into three sections	7
<u>2</u>	The foot as a simple lever (a) and as a segmented lever (b) floor print of a normal foot are also shown.	9
<u>3</u>	Bones forming the medial longitudinal, lateral longitudinal, and transverse arches of the right foot.	12
<u>4</u>	Different methods by which the arches of the foot may be supported.	13
<u>5</u>	A void excist between the navicular anteriorly and the calcaneus posteriorly.	17
<u>6</u>	Gait cycle.	22
<u>7</u>	Schematic diagram for the 10 subdivided zones of pressure distribution on foot.	26
<u>8</u>	Peak pressure plot.	32
9	Distribution of forces on the foot in three directions, towards the medial arch (A), towards the lateral arch (B), and (C) towards the posterior support.	34
<u>10</u>	Plantar pressure distribution and time period (percentage) in normal foot during stance phase of gait from heel strike to toe off.	37
<u>11</u>	Joint distribution of rheumatoid arthritis (RA; left) and osteoarthritis (OA; right).	42
<u>12</u>	Pathophysiology of rheumatoid arthritis.	46
<u>13</u>	Result of the dorsally extended position of the MTP joint the plantar plate is stretched dorsally and distally around the MT head.	48

No.	<u>Figure</u>	<u>Page</u>
<u>14</u>	Clinical photograph of hallux valgus deformity with subluxation of the lesser metatarsophalangeal joints and complex hammer toe deformities.	50
<u>15</u>	Plantar clinic photograph demonstrating lesser toe dislocation and plantar keratoses.	50
<u>16</u>	Plantar forefoot ulceration after chronic lesser metatarsophalangeal dislocation.	52
<u>17</u>	Midfoot arch collapse with migration of the talar head plantarward.	54
<u>18</u>	Hindfoot valgus in a patient with rheumatoid arthritis.	55
<u>19</u>	Clinical photograph of a pes planovalgus deformity with talar head subluxation plantarward.	57
<u>20</u>	Hallux valgus deformity with metatarsus primus varus.	63
<u>21</u>	Toe deformeties.	64
22	Palpation of the ankle joint.	66
<u>23</u>	Palpation of the second metatarsophalangeal.	67
<u>24</u>	Ankle joint: normal ranger of dorsiflexion and planter flexion.	68
<u>25</u>	Examination of the midtarsal joint.	70
<u>26</u>	Subtalar joint: Examination and range of movement.	70
<u>27</u>	The ankle joint: anterior Drawer sign: A tear of the anterior talofibular ligament.	72
<u>28</u>	VAS for pain assessment	73
<u>29</u>	How to calculate the DAS28 score.	75

No.	<u>Figure</u>	<u>Page</u>
<u>30</u>	An in-shoe based foot plantar pressure sensor by Pedar© Novel. Sensors (Basel).	79
<u>31</u>	An in-shoe based foot plantar pressure sensor F-Scan® System by Tekscan. Novel Quality in Measurement.	79
<u>32</u>	Plateform type.	79
<u>33</u>	(A) a peak pressure plot divided into 3 regions of interest: hindfoot, midfoot, and forefoot.	80
<u>34</u>	Longitudinal dorsal scan of the tibiotalar joint.	90
<u>35</u>	The arrows indicate US bone erosions of different sizes.	92
<u>36</u>	Foot-screening pathway.	101
<u>37</u>	Therapeutic ultrasound.	109
<u>38</u>	Depth & frequency of penetration of ultrasound waves.	110
<u>39</u>	Visual analogue scale (VAS).	120
<u>40</u>	Foot function index (FFI).	122
<u>41</u>	The Simplified Erosion and Narrowing Score (SENS) for scoring radiographic damage at the hands and feet in patients with RA.	124
<u>42</u>	The musculoskeletal ultrasound used in the study.	125
<u>43</u>	Examination of 1st and 2nd MTP joints by ultrasound.	126

No.	<u>Figure</u>	<u>Page</u>
44	(A) shows platform of Tekscan device (foot print) used in the study. (B) in standing (static) positions.(C) in dynamic conditions (taking 2steps).	131
<u>45</u>	Customized soft total contact insole (TCI) with metatarsal and medial arch supports used in the study.	132
<u>46</u>	Transcutaneous Electric Nerve Stimulation (TENS) used in the study.	133
<u>47</u>	Therapeutic ultrasound used in the study.	134
<u>48</u>	The frequency distribution of rheumatoid arthritis disease activity in our patients according to their modified DAS28 scores.	138
<u>49</u>	The frequency distribution of rheumatoid arthritis disease activity in our patients according to their modified DAS28 scores.	141
<u>50</u>	(A) Scatter plot between GSUS of the right foot before treatment and X-ray score (B) GSUS of the left foot and x-ray score.	148
<u>51</u>	(A) Scatter plot between GSUS before treatment and SPPP of the right foot (B) Scatter plot between GSUS before treatment and SPPP of the left foot.	149
<u>52</u>	(A) Scatter plot between PDUS of the right foot and X-ray score (B) Scatter plot between PDUS of the left foot and X-ray score.	151
<u>53</u>	(A) Scatter plot between PDUS of the right foot before treatment and SPPP of the right foot (B) Scatter plot between PDUS of the left foot and SPPP of the left foot.	152

No.	<u>Figure</u>	Page
<u>54</u>	(A) Scatter plot between visual analogue scale and disease duration. (B) Scatter plot between visual analogue scale and SPPP of the right foot. (C) Scatter plot between visual analogue scale and SPPP of the left foot.	154
<u>55</u>	(A) Scatter plot between foot function index% and DD (B) Scatter plot between foot function index% and SPPP of right foot (C) Scatter plot between foot function index% and SPPP of left foot.	156
<u>56</u>	(A) Scatter plot between SPPP of the right foot and DD (B) Scatter plot between SPPP of the left foot and DD.	158
<u>57</u>	(A) Scatter plot between SPPP of the right foot and X-ray score (B) Scatter plot between SPPP of the left foot and X-ray score.	159
<u>58</u>	(A) Scatter plot between X-ray score and DD (B) Scatter plot between X-ray score and VAS (C) Scatter plot between X-ray score and FFI%.	161
<u>59</u>	Bar chart, before and after treatment according to visual analogue scale and foot function index% in group A.	164
<u>60</u>	Bar chart, before and after according to gray scale ultrasound right and left foot in group A.	164
<u>61</u>	Longitudinal view of Left 2 nd MTP joint of the same patients showing, before and after treatment by TCI and physiotherapy and the improvement of synovial effusion and hypertrophy.	165

No.	<u>Figure</u>	<u>Page</u>
<u>62</u>	Longitudinal view of Left 1 st MTP joint of the same patients before and after treatment showing an improvement of synovial effusion and hypertrophy.	165
<u>63</u>	Bar chart, before and after according to visual analogue scale and foot function index% in group B.	167
<u>64</u>	Bar chart between group A and group B according to visual analogue scale (mm).	168
<u>65</u>	Bar chart between group A and group B according to foot function index%.	169
<u>66</u>	Bar chart between group A and group B according to gray scale ultrasound of right foot.	172
<u>67</u>	Bar chart between group A and group B according to gray scale ultrasound of left foot.	172
<u>68</u>	Bar chart between group A and group B according to power Doppler ultrasound of right foot.	173
<u>69</u>	Bar chart between group A and group B according to power Doppler ultrasound of left foot.	173

List of Tables

No.	<u>Table</u>	<u>Page</u>
1	The Most Common Joints Involved During the Course of RA.	41
<u>2</u>	Investigations and monitoring of rheumatoid arthritis.	61
<u>3</u>	European League Against Rheumatism/ American College of Rheumatology 2010 Criteria.	76
<u>4</u>	Physiotherapy Modalities and Rehabilitation Treatment Techniques Used in Rheumatoid Arthritis Patients.	106
<u>5</u>	Demographic characteristics of Studied RA patient.	137
<u>6</u>	The clinical parameters of the studied RA patients.	139
<u>7</u>	DMARDs taken by the studied RA patients.	141
<u>8</u>	Laboratory investigations in all RA patients.	143
9	VAS, FFI and SENS score for all studied RA patients.	144
<u>10</u>	SPPP & DPPP of right and left feet for all patients.	145
<u>11</u>	GSUS and PDUS grading for all patients before treatment.	146
<u>12</u>	Correlations between GSUS with all parameters for all patients before treatment.	147
<u>13</u>	Correlations between PDUS with all parameters for all patients before treatment.	150
14	Correlations between visual analogue scale with all parameters for all patients before treatment.	153

List of Tables

No.	<u>Table</u>	<u>Page</u>
<u>15</u>	Correlations between foot function index% with all parameters for all patients.	155
<u>16</u>	Correlations between static planter peak pressure and dynamic planter peak pressure with all parameters for all patients before treatment.	157
<u>17</u>	Correlation between x-ray with all parameters for all patients before treatment.	160
<u>18</u>	Comparison of variables parameters in group A before and after treatment.	163
<u>19</u>	Comparison of variables parameters in group B before and after.	166
<u>20</u>	Comparison of (VAS) between group A and group B before and after treatment.	168
<u>21</u>	Comparison between group A and group B according to foot function index before and after treatment.	169
22	Comparison between group A and group B according to VAS scale (mm), FFI% and gray scale & power Doppler ultrasound.	171



Introduction





Aim of the Work





Review of Literature

