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A Novel Multimodal Treatment for Management of Pain in Rheumatoid Arthritis; A Case Series

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Abstract: ***Aim: To present a novel understanding of Rheumatoid arthritis (RA) as a summation of motor neuropathy and an exaggerated expression of Hilton's law which links synovial irritation with muscle spasm leading to development of myofascial trigger points (MTrPs) and taut bands in muscles resulting in the severe pain, stiffness and inflammatory features of RA. Patients and methods: Six women on regular rheumatology care, sought our treatment for refractory pain(NRS 6.4+-0.85), stiffness and functional compromise in various joints as indicated by their disability of arm shoulder and hand (DASH right 58.83+-13.08, left 59.33+-14) and lower extremity functional scale(LEFS 42.33+-6.69) scores. They gave informed consent for pulsed radiofrequency (PRF) of whole innervation of the muscles responsible for knee/shoulder/elbow movement followed by ultrasound guided dry needling (USGDN) of affected muscles. After documenting the effects of PRF at 7 days USGDN was initiated and continued for8-10 sessions. Medications included paracetamol, chlorzoxazone, pregabalin and continued antirheumatic medications. Results: PRF reduced the rest pain and stiffness (50-70%) but not movement pains (30-50%) or RROM, activity levels and disability all of which improved after USGDN along with CRP reduction (n2). Wasted muscles regained their normal contours, DASH (right 61.7%, left 56.5%) and LEFS (68%) scores improved. NRS post treatment (0.66+-0.32). Conclusion: A novel perspective of motor neuropathy working independently and/or through Hilton's law helped develop effective treatments to reduce inflammation and hence relieve pain and stiffness in 6 RA patients. PRF and ultrasound guided dry needling (USGDN) target specific nerves and muscles directly involved in producing the inflammation.***

Keywords: Rheumatoid arthritis, neuropathic pains, ultrasound guided dry needling, PRF- pulsed radiofrequency. Hilton's Law

1. Introduction

Rheumatoid arthritis (RA) is an autoimmune disorder of unknown etiology characterized by symmetric, erosive synovitis, considerable disability, poor quality of life and, in some cases, extra-articular involvement. The global prevalence of RAthe 42nd highest contributor to global disability, remains unchanged at 0.24% from 1990 to 2010.[(1)] The synovitis presents with morning and whole day stiffness, restricted range of motion (RROM) in affected joints which progresses to deformities and disability. Treatment with anti-inflammatory drugs, disease modifying anti-rheumatic drugs (DMARDs) and biologics control inflammation well but pain continues to be a major problem[(2, 3)]. In this case series of 6 patients Pulsed Radiofrequency (PRF) of mixed nerves followed by ultrasound guided dry needling (USGDN) of painful muscles produced RA remission with significantly reduced pain, inflammation and stiffness.

2. Case Report

Six RA patients on regular rheumatology care presented with pain, morning stiffness and functional compromise in various joints. RA medications, DMARDs (n=5), steroids (n=2)and NSAIDS as needed], disability of arm shoulder and hand(DASH) score and lower extremity functional scale (LEFS) were documented. (table-1). Informed consent was taken for Pulsed radiofrequency (PRF) of the whole innervation of the muscles responsible for knee/shoulder/elbow movement (figures-1, 2) and for ultrasound guided dry needling (USGDN) of affected muscles. (table-2) (figure-3) Seven days later after documenting the effects of PRF, USGDN was initiated for the muscles involved in performing the restricted/painful movements of the concerned joint (table-2) and left in situ for 30 minutes, and then removed. Medications included Paracetamol (500 mg), Chlorzoxazone (250 mg), twice daily, pregabalin (75 mg) once a day and antirheumatic medications as per rheumatologist's advice.

3. Results

PRF significantly reduced the rest pain and morning stiffness (50-70% relief) but not movement pains, (30-50 % relief) stiffness or RROM, activity levels and disability. After 2-3 sessions of USGDN, patients reported distinct reduction of movement pain, morning stiffness (70-80% relief) improvement in RROM and CRP reduction (n=2).Walking and standing limits improved as wasted muscles regained their near-normal contours and DASH and LEFS scores improved. (Table-1)

4. Discussion

The quality of life for RA patients continues to be disappointing despite remarkable progress in treatment modalities. Narongroeknawin et al reported that 42% patients stopped treatments due to inadequate response, serious adverse events (22%), and nonadherence (14%). Only 13% stopped due to remission/low disease activity [(4).]Four of our patients (66%) stopped DMARDs due to side

effects and 2 others(33%) stopped due to inadequate pain relief.

Neuropathic pain has been cited to be the major component of RA pain[5, 6]. We have been working on the premise that neuropathies affect motor nerves (neuromyopathy) leading to increased firing at the neuromuscular junction with development of myofascial trigger points (MTrPs) that cause taut bands in muscles. These taut bands impede muscle movement (weakness, stiffness) cause tenosynovial friction with resultant enthesopathies with extraarticular inflammation (figures-4, 5)and significantRROMwhich worsens the already present synovial irritation due to RA.Repeated bouts of inflammation sending nociceptive signals from these structures augments the progression of peripheral and central sensitization.[7]

Another reason for RA pain is an exaggerated expression of Hilton's law[8] which links synovial irritation with muscle spasm. It states that "motor nerve fibers serving the muscles acting on the joint carry afferent input from joint and overlying skin".

It is this summation of muscle spasms from motor neuropathy (neuromyopathy) and Hilton's law that leads to an explosive development of MTrPs resulting in the severe exaggerated pain stiffness and inflammatory features of RAthat impacts joint function leading to the deformities.

Our combination of PRF and USGDN[9, 10] addresses both the neuro and myo aspect of neuromyopathy and hence relieved the stiffness as well as pain to post treatment NRS 0.66+-0.32.PRF of the mixed nerves that form the composite innervation of joints and muscles appears to reduce,

1) Afferent nociceptive traffic from the muscles
2) Efferent motor nerve irritation responsible for the development of MTrPs.
3) The exaggerated neural activity secondary to Hilton's law
4) The peripheral sensitization.

Hence patients report significant relief ofstiffness and pain in the joint, the extraarticular muscles and enthesopathic manifestation from tendons even though the genicular nerves were not addressed. We believe that this because the joint pains are expressed through referral to the muscles. However pain from already formed MTrPs, movement pains and RROM persist in spite of PRF.

USGDN targets these recalcitrant MTrPs, specifically reduces the inflammation in MTrPs[11], relaxes the taut band sand enables the muscles to return to their original non shortened state thereby reducing the enthesopathies of their respective tendons. There is a clear mathematically precise correlation between the muscle needled and reduction of pain, stiffness and enthesopathies (figures 4, 5).The net result is a clinical improvement which reflects the complex interplay between reduction in the inflammation of RA, resultant reduction of pain, peripheral and central sensitivity as well as a reduced expression of Hilton's law. These 6 patients had lasting, complete remission with significant pain relief and functional improvement for 1-3 years, even those with fixed deformities (patients 3-6, figure-6)
USG enables the accurate needle placement in agonist/ antagonist/ fixator/ synergist muscles that execute joint movements. Allows visualization of multiple local twitch reflexes (LTR) which confirm the presence of MTrPs in RA. LTR is the diagnostic hallmark of MTrPs and its occurrence has been shown to reduce inflammatory mediators in MTrPs.[11] USGDN eliminates MTrPs and taut bands that impede joint movements and cause enthesopathies thereby reducing not just pain but the actual inflammatory load in RA enabling muscles to execute unimpeded, pain free movements.

5. Conclusion

A novel perspective of motor neuropathy working independently and/or through Hilton's law opens up exciting and effective treatments to reduce inflammation and hence relieve pain and stiffness in RA where pain management has been historically suboptimal. PRF and USGDN are physical procedures that target specific nerves and muscles directly involved in producing the inflammation of RA to produce local effects at specific pain locations and don't add to the medication load. A controlled trial in large number of patients could prove the efficacy of this technique.

Patient demographics, pre and post clinical data Table 1

NO	Age sex RA duration Follow up period	(NRS)		DASH & LEFS scores		Limits in minutes with onset of pain				Investigations		Prior Treatment	Side effects	Intervention done
		pre	post	Pre	post	Standing		Walking		Pre	Post			
						Pre	post	Pre	post					
1	24 F 2 yr	6-10	0	Rt 32 Lt 33 LEFS 40	Rt 15 Lt 17 LEFS 70	30	No limitation	30	No limitation	RA factor- 47 IU/ml ESR- 65 mm	NA	HCQ Homeopathy		PRF of nerves around shoulders, elbow, knees, USGDN
2	49 F 6m	6-9	0-2	Rt 65 Lt 70 LEFS 36	Rt 13 Lt 15 LEFS 70	10	No limitation	10	No limitation	ESR 100mm CRP 25 mg/L RA factor-21.5 IU/ml Anti CCP- 153U/ml	CRP 14.1	NSAIDS steroids	Malena& abdominal distention	ONLY USGDN

3	52 F 18yrs FL	3-8	0-2	Rt 50 Lt 46 LEFS 48	Rt20 Lt 25 LEFS 66	5	30	5	20	RA +	NA	Indomethacin Sulfasalazine Methotrexate Steroids		PRF of nerves around shoulders, knees, USGDN
4	47 F 13yrs VS	4-8	0-1	Rt 60 Lt 57 LEFS 50	Rt 35 Lt 49 LEFS 70	40	90	30	60	CRP 30 mg/L	CRP 12	Indomethacin HCQ, Methotrexate Steroids. Bilateral THR, TKR	deranged vision, Koch's pleural effusion	PRF of nerves around shoulder and knees USGDN
5	44 F 15 yrs Ch	4-7	0-1	Rt 80 Lt 70 LEFS 50	Rt 25 Lt 20 LEFS 64	15	45	15	60	CRP 9.3mg/L ESR 110mm/hr ANA 1.3	NA	NSAIDS, Sulfasalazine, steroids, Ayurveda	Psychosis	PRF of nerves around shoulder, knee, USGDN
6	64 F 25yrs DD	4-8	0-2	Rt 66 Lt 80 LEFS 30	Rt 22 Lt 15 LEFS 70	5	45	5	45	RA positive	NA	HCQ Leflunomide Methotrexate steroids Ayurveda Homeopathy		PRF of nerves around shoulder and knee, USGDN

Table 2: Details of nerves receiving PRF and muscle receiving USGDN

Joints	PRF of Nerves: performed once at the start of treatment	USGDN of Muscles: total of 10-12 sessions up to 3 months. 4 biweekly sessions, then weekly for 1 month and fortnightly for 2 month and monthly for 2 sessions.
Shoulder	Spinal accessory, Dorsal scapular, suprascapular, Axillary, Subscapular nerves, Musculocutaneous, Lateral and Medial pectoral nerves Patients - 1, 3, 5, 6 – for 1 shoulder Patient 4 -both shoulders,	Splenius, Semspinalis, Trapezius Supraspinatus, Infraspinatus, Teres major& minor, Subscapularis, Rhomboids, Levator scapulae, deltoid, Biceps brachii, Triceps, Coracobrachialis, Pectoralis major& minor, Latssimusdorsi All 6 patients received USGDN for shoulder issues
Elbow	Musculocutaneous, Radial, Ulnar, Median Patient 1 – both knees Patient - 1	Biceps brachii, Brachialis, Triceps, Brachioradialis, extensors and flexors in forearm All 6 patients received USGDN for elbow issues
Knee	Femoral, Saphenous, Obturator, Tibial, common peroneal, Poplieal nerves. subsartorial&peripatellar plexus. The genicular nerve was not addressed in any of patients since our treatment premise is based on Neuromyopathy and Hilton's law and addresses the entire nerve supply of knee joint including the tibial nerve in popliteal fossa which gives rise to the medial superior and inferior genicular nerves and lateral genicular nerve. Patients – 1, 3, 4, 5, 6 - for both knees	Rectus femoris, Vastusmedius, intermedius & lateralis, sartorius, gracilis, adductors, back & buttock muscles, hamstrings, calf, Peronei All 6 patients received USGDN for knee and ankle issues
All 6 patients received USGDN of thenar, hypothenarinterossei and lumbricals was done to reduce finger and thumb pains and in patients 3, 4, 5, 6, for deformities Patient nos 3, 4 and 5 received USGDN of the adductor abductor flexor and extensor brevis muscles of foot as well as interossei and lumbricals for foot and toe deformities.		

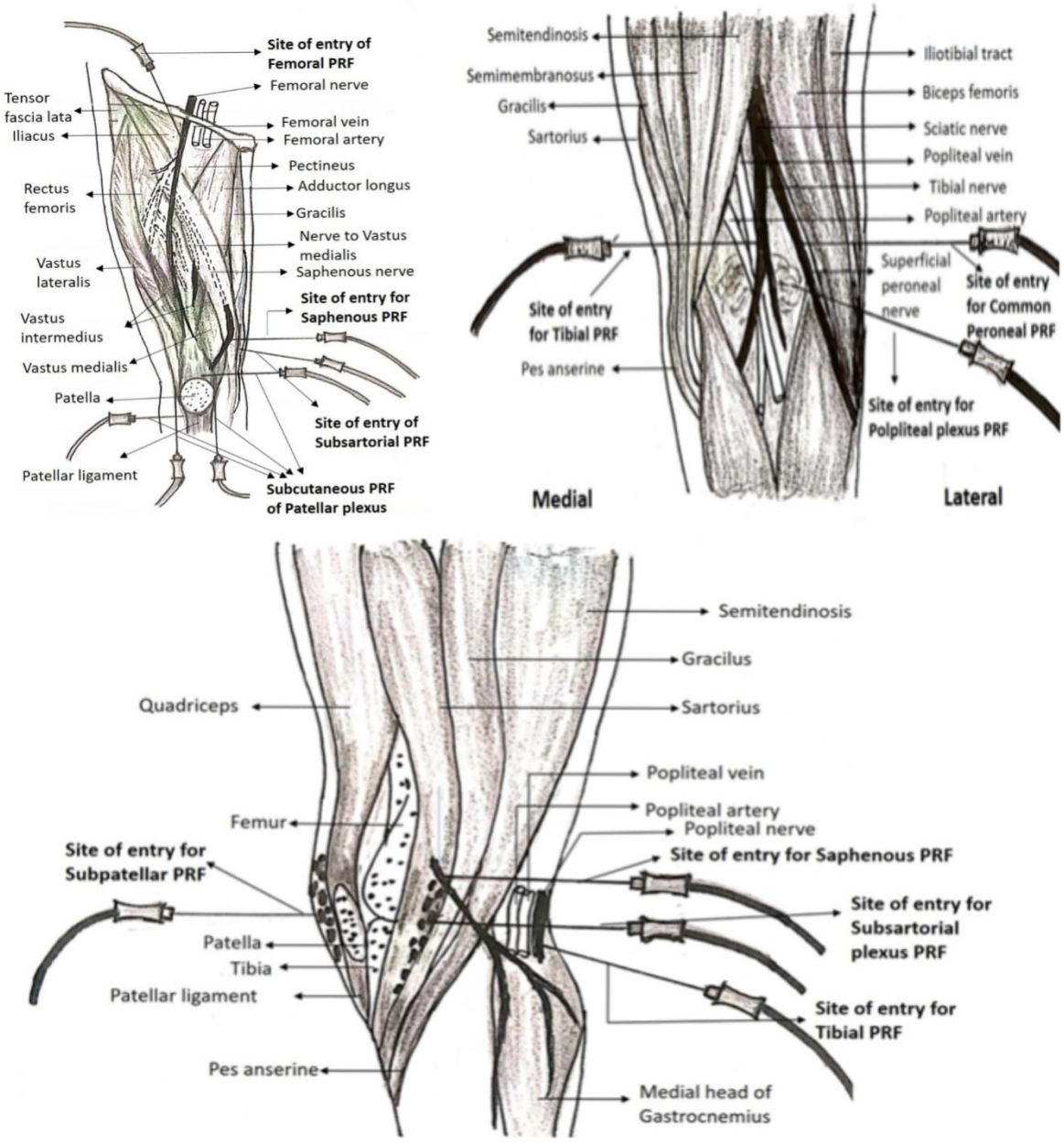

Figure 1: Relevant anatomy for PRF

Row 1 Lt: PRF of femoral N, posterior to lower end of sartorius, saphenous nerve in the substance of Sartorius & subcutaneous peripatellar plexus.

Rt: needles at CPN and TN. TN gives off all the three genicular N, hamstring, popliteus & calf muscles. Needle at popliteal vessels targets popliteal plexus.

Row -2shows the anteromedial aspect of knee. Needles at saphenous N, subsartorial plexus, TN popliteal plexus posteriorly &peripatellar plexus on Lt.

Abbreviations in all figures: minutes- Mn, left –Lt, right Rt, Nerve-N, Patient –Pt, Years –yrs, Rheumatoid arthritis- RA, Pulsed radiofrequency-PRF, Common peroneal nerve –CPN, Tibial nerve-TN, Weeks - wks

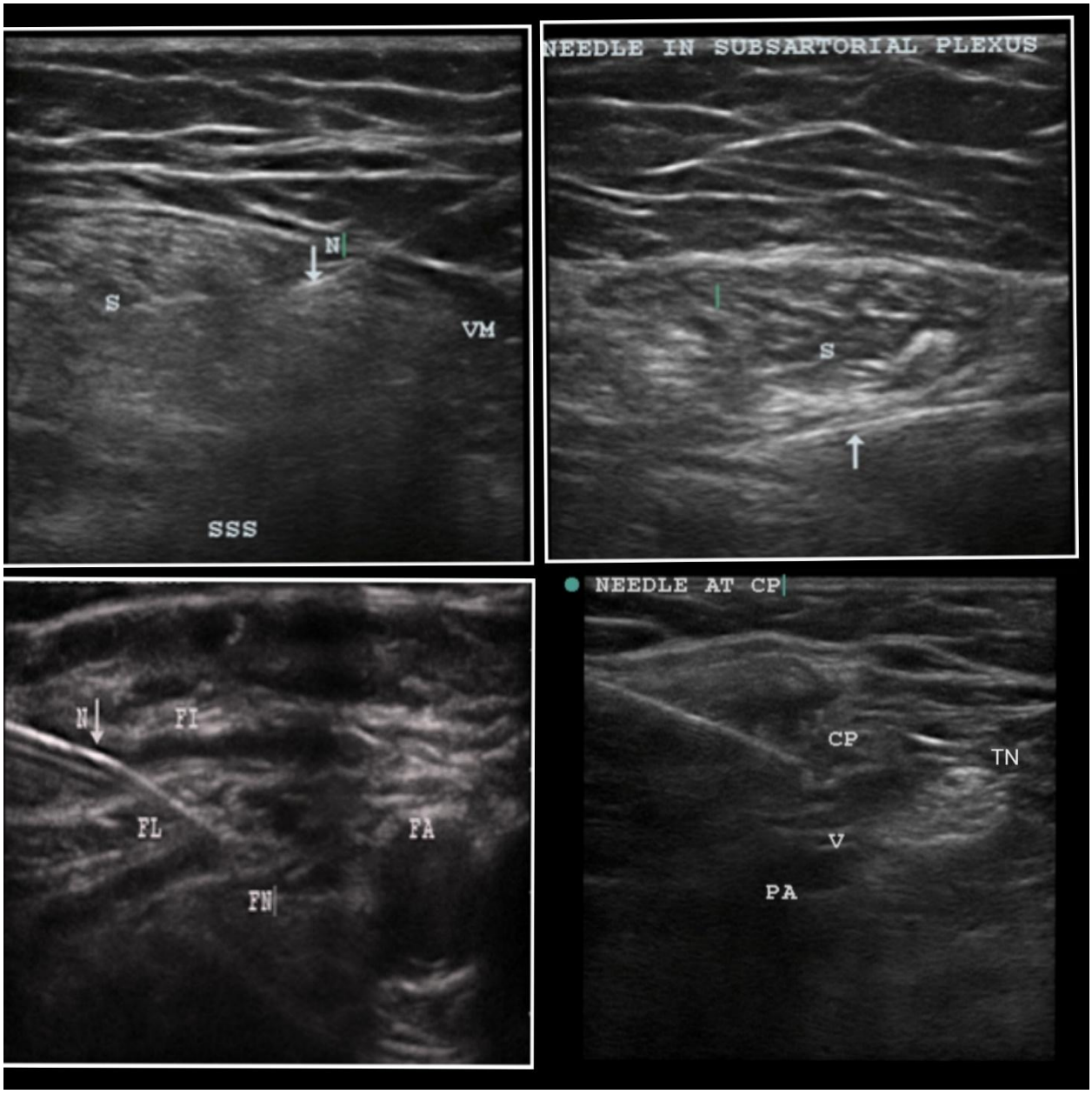

Figure 2: USG images of PRF of the knee
Row 1: Needle in sartorius &subsartorial plexus,
Row 2: Lt - Shows needle going through the fascia lata and Partly through fascia iliaca to the femoral nerve in Pt no5.

This image was chosen in spite of wrong labeling of fascia lata as FI and fascia iliaca as FL to show how the fasciae are thickened by 15 years of RA with effusion in between them (arrowhead). The Rt image shows PRF needle at CPN &TN

Figure 3: Clinical and USGDN images that correlate deformity with muscle pathology
Row 1- Fixed painful deformities in the thumb &fingers preventing purposeful movements in Pt no 5
Row 2 Lt- Needle is in flexor pollicis(FP) and in pronator teres(PT) and flexor carpi radialis(FCR) on the Rt.
Row 3 - She is able to flex &extend both her thumbs &fingers and finds her hand more useful.

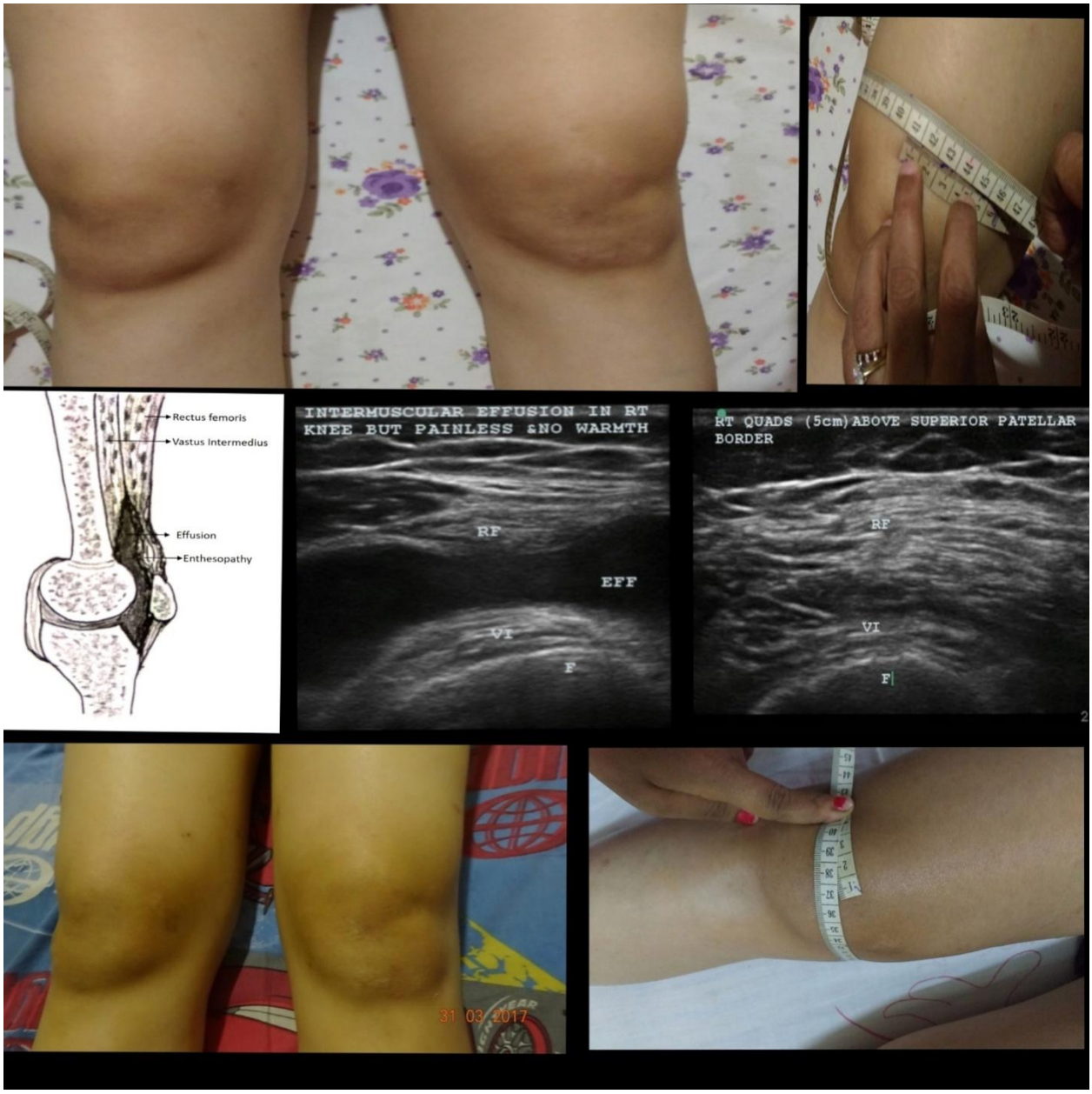

Figure 4: Clinical and USG images of effusion and its relief after PRF and USGDN with a diagrammatic representation of taut bands in quadriceps causing effusion.
Row 1- Pre treatment swollen Rt knee(41cm)of Pt no1.
Row 2 Lt; diagrammatic representation of taut bands with MTrPs (shown as knots in rectus femoris & deeper vastus intermedius muscles pulling at the tendons at patella causing irritation &effusion. Middle; Dumbbell shaped intermuscular effusion before treatment. Rt; Reduction of effusion post PRF+1month USGDN.
Row-3 Post treatment knee girth 36 cms.

Figure 5: RA problems and their relief by PRF and USGDN of affected muscles
Row 1 Lt - Painful fixed pronation & flexion deformity of elbow after 3Yrs RA in Pt no 1. Middle - Effusion at tendon of biceps, theprimary supinator &strong elbow flexor. Rt- PRF needle at MusculocutaneousN in Coracobrachialis. Median N PRF addressed pronators& digital flexors.
Row 2 Lt – Needle for radial N PRF to address elbow extensors.
Middle -USGDN of flexors &fibrosis in PT. Rt- Complete relief of deformity.

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