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Arthroscopic management of traumatic TFCC tears

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***Abstract*---**Background: Triangular fibrocartilage complex is a critical component of wrist biomechanics, serving important functions in both load transmission and distal radioulnar joint stability. This work aimed to assess the clinical outcome of wrist arthroscopy in the management of triangular fibrocartilage traumatic tears as a diagnostic aid and definitive therapeutic tool in terms of functional restoration, and patients' satisfaction. Methods: This prospective study included 27 patients diagnosed with TFCC tear. Patients were categorized in two groups: group I: had arthroscopic TFCC debridement for central tears and group II: had an arthroscopic assisted capsular TFCC repair. All patients were subjected to ulna carpal stress test, ballottement of the DRUJ, hand grip, evaluation scores [visual analogue scale, Mayo wrist score and patient-rated wrist evaluation score] and radiographic evaluation. Results: PRWE score was signifcantly improved in patients to whom TFCC debridement was done P <0.01. In patients to whom TC repair was done reported overall improvement of the PRWE score P < 0.02. Conclusions: The two patterns of tears included, and the short term follow up period, but has shown significant improvement following the arthroscopic intervention chosen for each pattern in a reproducible and predictable manner in the majority of our series.

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***Keywords*---**arthroscopic management, traumatic TFCC tears, arthroscopy.

Introduction

Ulnar-sided wrist pain is a frequent complaint and often a diagnostic challenge for clinicians. Presentations can vary from acute traumatic injuries to chronic degenerative conditions. Patients, more commonly than not, present with vague pain that is often chronic, and with neither gross abnormalities nor significant x-ray findings. Since first coined by Palmer and Werner (Palmer & Werner, 1981), the term triangular fibrocartilage complex (TFCC), our knowledge of the anatomic and biomechanics of the soft-tissue structures on the ulnar side of the wrist has vastly expanded. TFCC is a critical component of wrist biomechanics, serving important functions in both load transmission and distal radioulnar joint (DRUJ) stability. It also serves as a link between the carpus and the forearm, providing for smooth rotation of the radius around the ulna. A TFCC disruption can cause DRUJ instability and functional impairment due to ulnar-sided wrist pain and decreased grip strength.

TFCC injuries vary along a wide spectrum based on acuity and location. Unlike the degenerative tears which are often associated with ulnar impaction and are usually best treated with debridement or ulnar shortening procedures, the traumatic tears of the peripheral portion of the TFCC have been shown to have adequate blood supply and potential to heal, analogous to the meniscus of the knee. Despite the advancement in our understanding of these injuries, controversies remain regarding the management of traumatic injuries of the TFCC. Recommended treatment not only depends on the patient functional demands and symptoms, but also the location and chronicity of the tear, concomitant pathology, and the anatomic features of each individual radiocarpal and distal radioulnar joints. The aim of this work is to assess the clinical outcome and results of wrist arthroscopy in the management of triangular fibrocartilage traumatic tears as a diagnostic aid and definitive therapeutic tool in terms of functional restoration, and patients' satisfaction.

Materials and Methods

Patients

This prospective study included 27 patients who were presumptively diagnosed with TFCC tear and underwent an arthroscopic procedure to confirm the diagnosis, assess the tear suitability for debridement or repair, and proceeding accordingly. All patients included in this study were older than 16 years of age and all patients were operated upon after at least 3-month period of conservative treatment. According to the Palmer's classification (Palmer, 1990), only IA (central tears) and IB (ulnar tears) types were included. An informed written consent was obtained from the patient or relatives of the patients. The study was done after approval from the Ethical Committee Tanta University Hospitals.

Exclusion criteria

Were skeletally immature patients i.e younger than 16 years, no old age bracket was set but wrist or DRUJ radiological degenerative changes presence qualified, preoperative frank DRUJ instability compared to the asymptomatic contralateral side, more than 2mm positive ulnar variance and distal radius malunion. Patients were categorized in two separate groups: group I: had arthroscopic TFCC debridement for central tears and group II: had an arthroscopic assisted capsular TFCC repair. All patients were subjected to history taking, look, feel and move examination, special tests [ulna carpal stress test, ballottement of the DRUJ and hand grip], evaluation scores [visual analogue scale (VAS) for pain (Hawker, Mian, Kendzerska, & French, 2011), Mayo wrist score (Amadio et al., 1989) and patient-rated wrist evaluation score (PRWE Score) (MacDermid, Turgeon, Richards, Beadle, & Roth, 1998)] and radiographic evaluation.

Operative technique

Marking bony landmarks and portals was the initial step which was done after traction was applied. Lister's tubercle is the main bony landmark that is used to identify the portals. A needle was introduced into the 3-4 portal within the soft spot of the wrist just 0.5 cm distal to the Lister's tubercle. The needle was removed, and the skin was then incised longitudinally with the tip of a no. 11 blade. A blunt haemostat was used to navigate down to and through the joint capsule. The arthroscopy sheath with a blunt trocar for the 2.7mm arthroscope was then passed respecting the radiocarpal joint tilt, just distal to the Lister tubercle. The blunt trocar is then replaced by the arthroscopic camera, and a dry diagnostic arthroscopy is started in a sequential manner. The 6R portal was routinely made under direct visualisation of the scope using a hypodermic needle introduced just radial to the ECU tendon followed by introduction of a probe. This portal was initially used as the main working portal and could be well used as an outflow portal (del Piñal, 2011).

The radiocarpal joint

The articular surfaces of the scaphoid, lunate, and the corresponding fossae on the radius followed by visualisation and probing of the volar radiocarpal ligaments and the scapholunate ligament.

The ulnocarpal joint

The scope was then directed ulnarwards. Sometimes, switching the viewing portal to 6R can be helpful in assessing the ulnar structures. The TFCC was examined to check resilience of the disc using trampoline test and probed to identify a proximal detachment when the articular disc could be lifted with a probe (the hook test). When a tear is encountered, it was then graded regarding its site, the stability of the TFCC and associated lesions.

The midcarpal joint

The midcarpal joint was routinely inspected after establishing the radial and ulnar midcarpal portals in order to exclude ligamentous lesions, particularly scapholunate and lunotriquetral ligaments, in addition to the articular cartilage of the carpal bones.

Technique of central tears debridement

Once diagnosis is made of a central tear with intact deep and superficial radioulnar ligaments attachments, the tear is further exposed through limited synovectomy and adequate debridement of frayed tissue and fibrocartilaginous flaps till healthy appearing ligament is visualised. Typically, the procedure is started with a foot pedal-controlled shaver that allowed continuous or oscillating cutting. The edge is then tidied up and smoothened with a few touches by a radiofrequency probe.

Technique of IB Tears Capsular Repair

This type of repair was chosen after DRUJ was clearly deemed stable through clinical examination and arthroscopic assessment. The tear was then cleared of the overlying reactive synovitis. Also, the peripheral edge of the tear and the capsular bed is freshened with the shaver. 6U portal is added through a 2 cm extension to allow identification and protection of the superficial sensory branch of the ulnar nerve. The 6th extensor tendon compartment was then opened, and the ECU tendon is pulled ulnarwards to expose it subsheath overlying the ulnar capsule. A shuttle loop using a Prolene suture (3/0 or 4/0) is threaded into an 18-gauge needle and inserted into the wrist joint just inferior to the 6-U portal aiming to capture the capsule and a good bite of the ulnar torn edge of the TFCC articular disc under arthroscopic guidance. A second needle of similar size was fed with the definitive PDS suture and delivered through the capsule, TFCC edge, and the first loop of Prolene introduced into the joint. The Prolene loop was used as a shuttle to pull the PDS limb out of the joint and knot was tied onto the capsule carefully. Alternatively, a suture retriever was used through the 6R portal to grab the Prolene loop and PDS suture outside the joint to shuttle it back through the disc. The force used on tying the sutures was aimed to re-establish the TFCC tension and obliterate any gapping between the articular disc and the peripheral capsular tissue. Tying the knots had to be done after the traction is slackened to avoid false tension of the tissues, with the forearm is in neutral rotation. A trick is to tie an arthroscopic slip knot to help slide the suture down against the tendon sheath of the ECU with tension. ECU sheath then is carefully repaired as potentially, the ECU would be more vulnerable for subluxation or instability if the sheath is not fully closed or does not heal.

Statistical analysis

SPSS for Windows (version 11.0) was used for data management and statistical analysis. Ordinal and nominal data are described as absolute and relative frequencies. Continuous data are expressed as average, standard deviation, minimum, and maximum. The preoperative and postoperative measurements were compared using the paired samples t test. We investigated the difference in the VAS and MWS using the Wilcoxon signed rank test. Statistical significance was accepted at $P < .05$. The results of all statistical tests have to be interpreted in an exploratory sense.

Results

Table 1 shows Age, gender distribution, affected side hand dominance, history of Trauma, ulnar variance, and tear pattern of the studied patients. The improvement in the Mayo wrist score postoperatively was statistically significant. (p value < 0.05, $p = 0.000$). Pain at rest before the operation ranged from 0-6 with at a mean of 3.6. Pain at rest after the operation ranged from 0-4 at a mean of 1.4. Pain at exertion before the operation ranged from 4-9 at a mean of 4.8. Pain at exertion after the operation ranged from 0-9 at a mean of 3.1. Table 2. In patients to whom TFCC debridement was done, PRWE score improved from a mean of 67.31 to a mean of 37.31. This reflects a statically signifcant P value of <0.01. Figure 1. The mean pre-operative power grip of group-I was 67% and an overall improvement of the mean to 76.36 % was found. Figure 2.

The improvement in the Mayo wrist score postoperatively was statistically significant. (p value < 0.05, $p = 0.002$). Before the operation, pain at rest was graded by the patient on a range from 1- 6 with at a mean of 3.1. Pain with exertional activities before the operation ranged from 3-9 at a mean of 5.1. Pain at rest after the operation ranged from 0-4 at a mean of 1.2. Pain at exertion after the operation ranged from 1-9 at a mean of 2.9. Table 3. In patients to whom TC repair was done, patient reported overall improvement of the PRWE score from a mean of *73.85* to a mean of *42.28* with P value of < 0.02. Figure 3. Compared to the other side, the mean pre-operative power grip of Group-II was 53.14% and an overall improvement of the mean to 72 % was found. Figure 4.

Discussion

Clinical examination, X-rays, and MRI examination may be helpful to reach a diagnosis of TFCC injury. However, wrist arthroscopy surpasses by its ability to confirm, grade and treat all different patterns of injuries as well as other associations, and therefore considered the diagnostic gold standard. Consequently, it is becoming mainstream practice to base any treatment algorithm upon wrist arthroscopy modalities (Mehta, Garg, Ansari, Srivastava, & Kotwal, 2019). We found significant improvement on the short-term evaluation for MWS, PRWES and VAS. Our results confirmed the findings of previous studies aimed at similar research hypothesis (Minami, Ishikawa, Suenaga, & Kasashima, 1996; Whipple & Geissler, 1993). The majority of patients (19 patients -70.37%) in this series were diagnosed with Type IA tear which was addressed with partial debridement of the central portion of the disk preserving the integrity of the dorsal and palmer radioulnar ligaments. Functional outcomes assessed by the MWS were improved significantly at final follow up in 12 patients (63.15%) who had good to excellent scores, while 7 patients (36.84%) had fair to poor scores. Our results resonated with the biggest systematic review to our knowledge, Saito et al (Saito, Malay, & Chung, 2017) analysed the results of 18 studies with a total of 550 patients who had TFCC arthroscopic management and reported among the

TFCC debridement groups a mean DASH was 0 (indicating no disability), 81% patients had no pain after treatment, and 70% of patients achieved excellent clinical outcomes.

Interestingly, the studies published by Farr et al. (Farr, Zechmann, Ganger, & Girsch, 2015) and Farr et al. (Farr, Schüller, Ganger, & Girsch, 2018) were suitable for a descriptive comparison as both studies included cases performed by the same surgeon. Patients with arthroscopic debridement shown improvement of the preoperative MWS from 65 to 88 postoperatively. Mean postoperative ROM and mean postoperative grip strength (86%) were significantly improved as well in those who received sole debridement. Compared to our short term follow up with an average of 11.7 months, Minami et al (Minami et al., 1996) investigated the results of 16 cases after a mean follow-up of 35 months. Their overall results were excellent in 13 of 16 patients but slight pain remained in eight wrists, and 3 patients were dissatisfied due to moderate to severe residual pain. Another group looked at using a radiofrequency probe to perform the disk debridement and reported good and excellent outcomes according to the MWS in 85% of the cases (Darlis, Weiser, & Sotereanos, 2005). We only used the radiofrequency probe very judiciously to flatten the edges of the disc after debriding the main bulk using an oscillating shaver. Our concern was the negative effect of the heat on the articular cartilage since a readily available method is as effective (Sotereanos et al., 2009).

In our study, we recruited 8 patients who had an MRI-confirmed superficial TFCC tear. We were strictly consistent with the repair technique performed. All patients in this group had an arthroscopic assisted repair with reattachment of the TFCC to the capsule through an outside-in technique using absorbable suture material. Seven patients who committed to their follow up visits had an overall improvement of MWS from a mean of 53.5 to 71.87, mean PRWE 73.85 to 42.28, and VAS reduction to 3.1 and 5.1 at rest and exertion, respectively, reflecting statistically significant improvement. These results were not contradictory to what Estrella et al (Estrella, Hung, Ho, & Tse, 2007) reported after arthroscopic capsular repair of TFCC tears using a similar technique as 74% of patients in their study had good to excellent functional outcomes and 68% of patients returning to their original work at an average of 5 months after repair. Haugstvedt and Husby (Haugstvedt & Husby, 1999) also reaffirmed this method as a viable option, reporting 70% excellent results after surgery but their sample was heterogeneous as they included patients with DRUJ instability, chondral injury and distal radius fractures.

In a multicenter study of arthroscopic TFCC repairs with an average follow-up of 37 months, Corso et al. (Corso et al., 1997) reported that 29 of 45 wrists were rated as excellent, 12 as good, and 4 as poor. Although there was no control group, they concluded that an arthroscopic technique for TFCC repair minimizes soft tissue trauma, provides improved appearance, and leads to a quicker recovery than does open repair. In a study by Wysocki and colleagues (Wysocki, Richard, Crowe, Leversedge, & Ruch, 2012) , who managed to recruit a group of higher physical demands patients and applied the same outside in repair technique to address their complex superficial TFCC injuries. Twenty-five patients (90%) were available for follow-up at a mean of 31 months. The mean VAS score improved from a pre-operative score of 5.4 to a score of 0.9 at the final follow-up.

Out of 11 high-level athletes in the total cohort, 7 patients (64%) were able to return to sports, however, athletes who bore weight through their hands were unable to return to their sporting activity.

Ulnar variance is undoubtedly an important factor to be considered whenever TFCC injury is suspected. In our study, it was felt that positive ulnar more than 2 mm will be a confounding variable to the results of the addressing traumatic injuries to articular disc as a degenerative background to the disk can never be excluded. Therefore, we tried to minimise heterogeneity of the results by excluding high degrees of ulnar positive variance. On the contrary, recent study conducted by Papapetropoulos et al (Papapetropoulos, Wartinbee, Richard, Leversedge, & Ruch, 2010) examined cases of Palmer type 1B lesions with coexistent positive ulnar variance and concluded that these situations could be managed equally well with repair or ulnar shortening osteotomy. In contrast, Bednar et al (Geissler & Short, 2005) suggested in their research that a simultaneous ulnar shortening osteotomy was not necessary, provided no signs of ulnar impaction were present. The authors stated that TFCC repair could be successful even in cases with dynamic positive ulnar variance. Tatebe et al (Tatebe et al., 2007) found that ulnar shortening osteotomy before repair resulted in beneficial effects on the repair of the torn TFCC.

The precise mechanism in which TFCC tears lead to pain is not clearly explained or accounted for in the literature. An anatomical study by Gupta et al. (Gupta, Nelson, Baker, Jones, & Meals, 2001) has mapped out the innervation the TFCC and showed that it is mainly supplied by the posterior interosseous nerve in the dorsal aspect, the dorsal sensory branch of the ulnar nerve in the ulnar aspect, and the ulnar nerve in the palmar aspect, with no innervation on the radial or central aspect. Injury to these nerves might be the reason for the persistent pain. Thus, the dorsal and ulnar approaches to TFCC repair carry a high risk of injury to the nerve supply. In our study, the incidence of paresthesia of the dorsal sensory branch of the ulnar nerve is quite high (4 patients-15-38%). This is relatively more than what is frequently reported, the incidence of ulnar nerve paresthesia from arthroscopic repair of the TFCC was around 4% in more than one study (Corso et al., 1997; Trumble, Gilbert, & Vedder, 1996).

Limitations: Perhaps the greatest weakness of our research is that two patterns of tears were included, and this created, to some extent, heterogeneity in the overall outcomes. Other limitations of this study are that it is a non-randomized case series which included a relatively small number of patients, without a control group. There was also a vast demographic distribution of patients with a relatively short-term follow-up. Also, the same surgical team, who performed the surgery, examined the patients after surgery; therefore, there was no blinding. Future well-designed prospective randomized studies with larger patient numbers with treatment/no treatment arms are required to validate the positive outcomes and subsequently declare clear guidelines to the management of TFCC traumatic injuries and unify the extreme controversies across the literature.

Conclusions

The two patterns of tears included, and the short term follow up period, but has shown significant improvement following the arthroscopic intervention chosen for each pattern in a reproducible and predictable manner in the majority of our series.

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Conflict of Interest: Nil

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Tables

Table 1
Age, gender distribution, affected side hand dominance, history of Trauma, ulnar variance, and tear pattern of the studied patients (n = 27)

		Patients (n = 27)
Age (years)	<20	2 (7.4%)
	20-<40	21 (77.77%)
	>40	4 (14.81%)
Gender	Male	14 (51.85%)
	Female	13 (48.14%)
The affected side hand dominance	Dominant hand	17 (62.96%)
	Non-dominant hand	10 (37.03%)
Injuries	Sport-related	14 (51.85%)
	Non-sport-related	9 (33.33%)
	Unrecalled	4 (14.81%)
Ulnar variance	Neutral variance	17 (62.96%)
	Negative variance	6 (22.22%)
	Positive variance	4 (14.81%)
Tear Pattern	Type IA	19 (70.37%)
	Type IB	8 (29.62%)

Data are presented as frequency (%)

Table 2
Final outcome based on Mayo Wrist score and Visual Analogue Pain Scale in group I (n = 19)

			Patients (n = 19)	P value
Mayo Wrist Score	Excellent		3 (15.78%)	-----
	Good		9 (47.63%)	
	Fair		6 (31.57%)	
	Poor		1 (5.2%)	
Visual Analogue Pain Scale	At rest	Pre-operative	3.6	0.001*
		Post-operative	1.4	
	With exercise	Pre-operative	4.8	0.001*
		Post-operative	3.1	

Data are presented as mean ± SD or frequency (%)

Table 3
Final outcome based on Mayo Wrist score and Visual Analogue Pain Scale in group II (n = 7)

			Patients (n = 7)	P value
Mayo Wrist Score	Excellent		1 (14.28%)	------
	Good		4 (57.14%)	
	Fair		1 (14.28%)	
	Poor		1 (14.28%)	
Visual Analogue Pain Scale	At rest	Pre-operative	3.1	0.02*
		Post-operative	1.2	
	With exercise	Pre-operative	5.1	0.001*
		Post-operative	2.9	

Data are presented as mean ± SD or frequency (%)

Figures

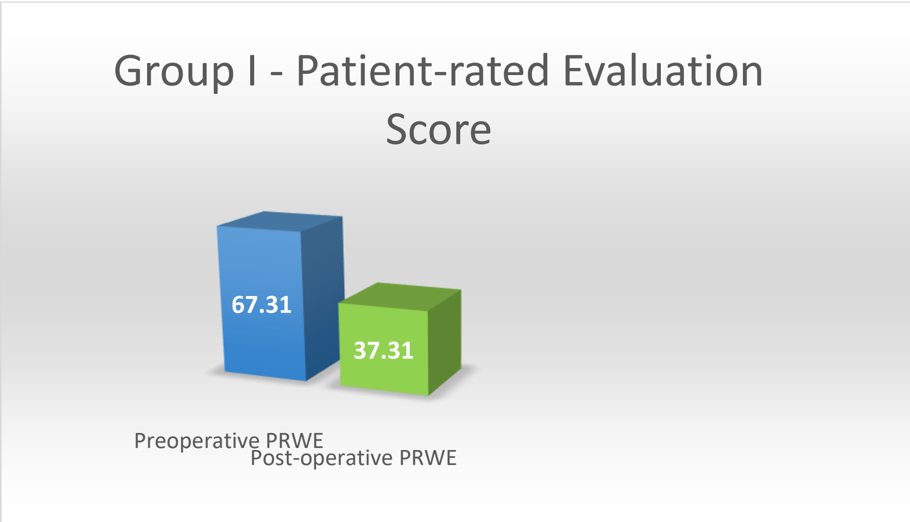

Figure 1. Final outcome based on Mayo Wrist score

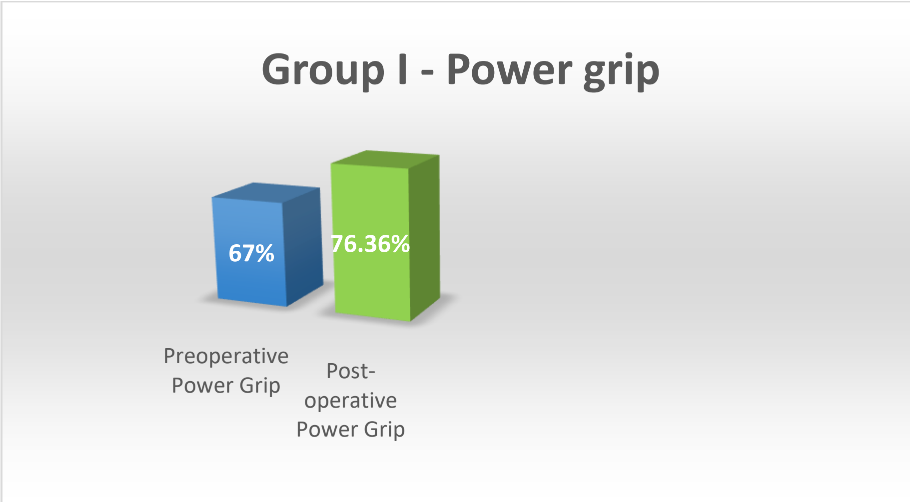

Figure 2. Pre and post-operative mean power grip

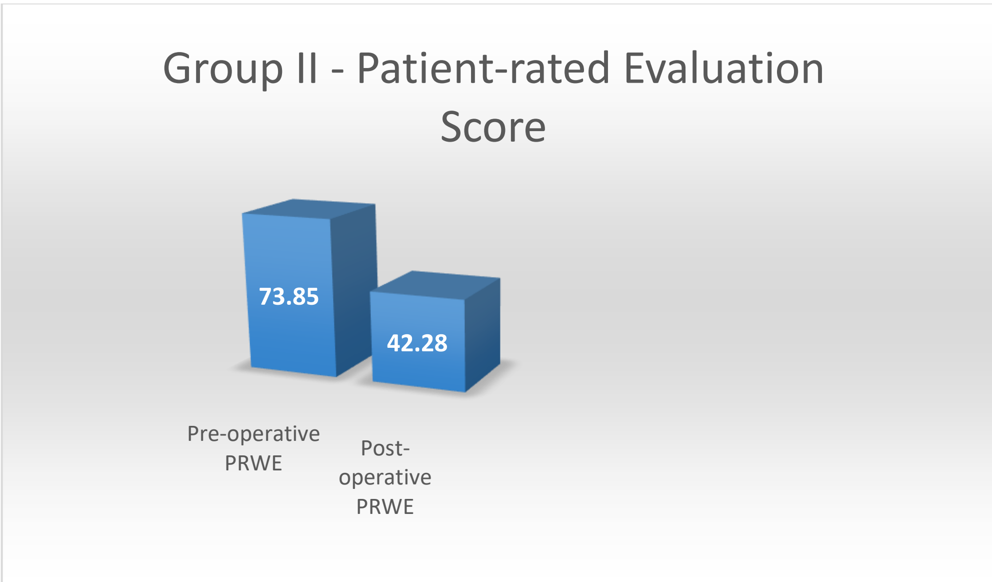

Figure 3. Final outcome based on Mayo Wrist score

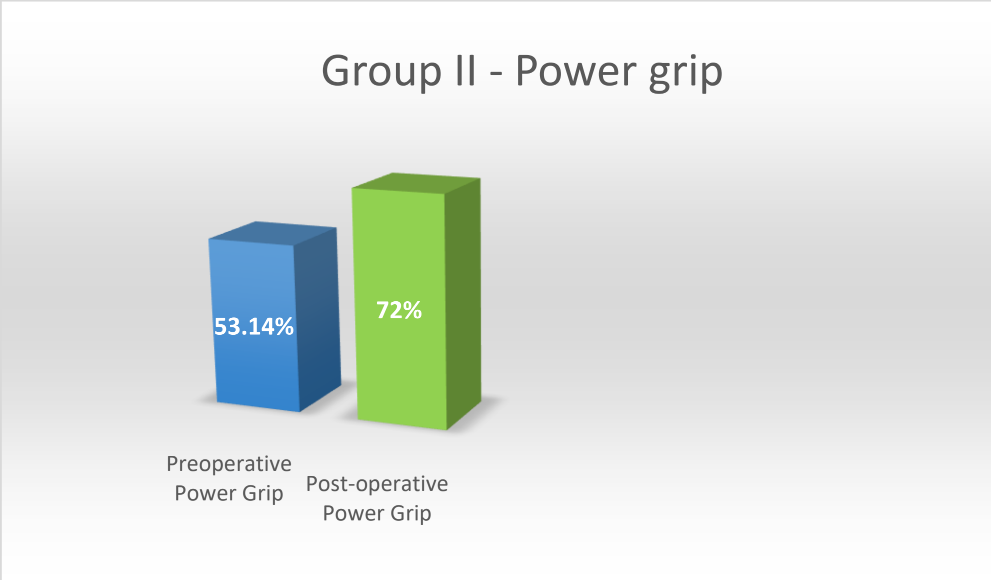

Figure 4: Pre and post-o