





Use of a larger surface area tip on bipolar radiofrequency wands in hip arthroscopy is associated with significantly lower traction and total surgery times

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ABSTRACT

Clinical outcomes in arthroscopic hip preservation surgery have improved over the past two decades due to many factors, including advancements in technique and instrumentation. Complications following hip arthroscopy are associated with increased traction and overall surgical times. The purpose of this study was to compare traction and surgical times during hip arthroscopy using two different radiofrequency ablation wands produced by the same manufacturer. The authors hypothesized that the wand with a larger surface area would result in significantly less traction and surgical times. This study was a retrospective comparative investigation on patients who underwent arthroscopic surgery of the central, peripheral, peritrochanteric and/or deep gluteal space compartments of the hip. Both wands are 50-degree-angled probes, but the tip and shaft diameters are 3 and 3.75 mm for Wand A (Ambient Super MultiVac 50; tip surface area 7.1 mm²) compared to 4.7 and 4.7 mm for Wand B (Ambient HipVac 50; tip surface area 17.3 mm²), respectively. There was no difference ($P = 0.16$) in mean age of Wand A patients (30 females, 20 males; 35.2 years) versus Wand B patients (31 females, 19 males; 32.7 years). Traction time was significantly less in the Wand B group (41 ± 6 versus 51 ± 18 min; $P < 0.001$), as was surgical time (102 ± 13 versus 118 ± 17 min; $P < 0.001$). There were no significant differences in the number of labral anchors used or Current Procedural Terminology codes performed between groups. In conclusion, it was observed that the use of a larger surface area wand was associated with significantly less traction and surgical times during hip arthroscopy.

INTRODUCTION

Clinical outcomes in arthroscopic hip preservation surgery have significantly improved over the past two decades largely due to better patient selection and innovations in surgical technique. The learning curve of hip arthroscopy is significant, with lower rates of re-operations in more experienced surgeons [1–3]. The most important aspects of the procedure include the correction of cam morphology and labral preservation [4]. For these components of the procedure, among others in the central, peripheral, peritrochanteric and deep gluteal space compartments, proper visualization is necessary in this deep, constrained joint. Visualization can be improved using a variety of instrumentation, including mechanical resection and radiofrequency ablation devices. Due to the anatomy of the hip, traction is required to access the central compartment for chondrolabral surgery. Unfortunately, the risk of complications is significant with the use of traction, primarily due to the time and magnitude of compression from the perineal post. These injuries may present as pudendal nerve injury, genitourinary and gynecologic soft tissue damage [5, 6]. These complications can be devastating and have been correlated with multiple factors among which include

the magnitude of distracting force and duration of traction [7–9]. Thus, any innovation that can improve the surgical technique by reducing complication risk is welcomed.

Many surgical techniques have been described to mitigate hip arthroscopy complications including perineal post positioning, size and design, as well as altogether postless techniques [10–12]. As with other surgeries, surgeon experience is critical to reduce operative time [13]. Technological advancements are another factor affecting operative time and surgical complications [14]. The development of specialized hip arthroscopy instrumentation has enabled more procedures to be undertaken, given there is a larger muscular envelope and deeper subcutaneous fat layer surrounding the hip joint. Longer, flexible instruments are thought to be beneficial in accessing aspects of the central and peripheral compartments of the hip joint relative to more superficial joints [15].

During hip arthroscopy, radiofrequency ablation is important for removing synovium and capsule during the interportal capsulotomy and for removal of periosteum prior to femoral osteoplasty. The purpose of this study was to compare traction and surgical times during hip arthroscopy using two different

bipolar radiofrequency ablation wands produced by the same manufacturer. The authors hypothesized that the wand with a larger surface area would result in significantly less traction and surgical times than the smaller surface area wand.

METHODS

This study was a retrospective comparative case series of patients treated by a single surgeon at a single institution between June 2016 and February 2017. Institutional Review Board approval was obtained. Electronic medical record review was conducted on the first 50 hip arthroscopy cases with the use of a new radiofrequency ablation wand designed for hip arthroscopy (Ambient HipVac 50; Smith & Nephew, Andover, MA, USA). In order to minimize the effect of the single surgeon's learning curve, the 50 hip arthroscopy cases performed prior to the use of the new radiofrequency wand were used as a comparison group. During these preceding 50 cases, a smaller tip, smaller diameter and less rigid wand, not specifically designed for hip arthroscopy, was used (Ambient Super MultiVac 50; Smith & Nephew, Andover, MA, USA). For the purposes of this investigation, the wand used earlier in the investigation eligibility period was designated Wand A (Ambient Super MultiVac 50) and the wand used later in the investigation eligibility period was designated Wand B (Ambient HipVac 50). Both wands are 50-degree-angled probes, but the tip and shaft diameters are 3 and 3.75 mm for Wand A (Ambient Super MultiVac 50; tip surface area 7.1 mm²) compared to 4.7 and 4.7 mm for Wand B (Ambient HipVac 50; tip surface area 17.3 mm²), respectively. Thus, the surface area of the tip of Wand B is 2.45 times larger than that of Wand A. The surgeon was similarly experienced with both wands at the beginning and throughout the study, and all cases occurred within 9 months of each other to mitigate any hip arthroscopy learning curve effects. The similarity of each surgical case was evaluated by the number of anchors used for labral repair and number of Current Procedural Terminology (CPT) codes performed [16].

Inclusion criteria consisted of male and female patients of any age or diagnosis who had undergone primary or revision arthroscopic surgery of the central, peripheral, peritrochanteric and/or deep gluteal space compartments. Patients with advanced arthritis or dysplasia and patients who underwent concurrent open hip surgery (e.g. periacetabular osteotomy, femoral osteotomy, open tendon repair and total hip arthroplasty) were excluded. Surgical indications included femoroacetabular impingement syndrome, labral tears, peritrochanteric or deep gluteal space diagnoses that had failed at least 3 months of nonsurgical treatment. Hip arthroscopy was performed with the patient in the supine position, and traction was achieved using a well-padded perineal post. Three standard portals were utilized for the central and peripheral compartments (anterolateral, modified mid-anterior and distal anterolateral accessory portals). Additional peritrochanteric accessory portals were utilized for the peritrochanteric and deep gluteal space compartments. Labral repair was performed using all-suture anchors with either a circumferential looped or a labral base refixation mattress technique, depending on labral size and quality. Cam, pincer and subspine corrections were performed using a burr to restore femoral head-neck junction sphericity and appropriate acetabular coverage,

Table I. Patient demographics

	W and A	W and B	P-value
Mean age (years)	35.2 ± 14.8	32.7 ± 13.3	0.16
Females	30	31	–
Males	20	19	–

respectively. Routine T-capsulotomy was performed for exposure using a small interportal capsulotomy (<2 cm) and a vertical T limb extension above the zona orbicularis. Routine complete capsular closure was performed.

Traction time, total surgical time (skin incision to incision closure), number of anchors placed, intraoperative anchor pullout, magnitude of cam/pincer correction, concomitant procedures, radiofrequency ablation wand type and patient demographics were collected. Once traction was discontinued with completion of central compartment work, in this investigation, it was not re-established at any point during the surgery. Data extraction was recorded and managed in Microsoft Excel. Descriptive statistics were calculated, and continuous data were presented as mean ± standard deviation. A two-proportion z-test was used to determine if there were significant differences in the data collected between the groups. Statistical significance was set at $\alpha = 0.05$.

RESULTS

The mean age of Wand A patients was 35.2 ± 14.8 years (range, 14–75 years), and Wand A constituted of 30 female and 20 male patients. The mean age of Wand B patients was 32.7 ± 13.3 years (range, 14–58 years), and Wand B constituted of 31 female and 19 male patients (Table I). No adverse events (e.g. breakage, non-functional and thermal) related to wand use occurred during the eligibility period. The intraarticular temperature remained below 45°C for all procedures during the eligibility period.

Traction time was significantly less in the larger surface area (Wand B) wand group (41 ± 6 versus 51 ± 18 min; $P < 0.001$). Surgical time was also significantly less in the larger surface area (Wand B) wand group (102 ± 13 versus 118 ± 17 min; $P < 0.001$). Regarding case similarity, it was found that there were no significant differences between the two groups in terms of the number of labral anchors used in the Wand A group compared to the Wand B group (3 ± 0.8 versus 3.1 ± 0.9; $P = 0.32$), as well as the number of CPT diagnosis codes billed (5.5 ± 1.2 versus 5.2 ± 1.4; $P = 0.12$) (Table II). There were no complications, including traction-related adverse events (e.g. neuropraxia and perineal soft tissue injury), in either group.

DISCUSSION

The results of this study suggest that the use of a larger surface area wand is associated with significantly lower traction and surgical times during hip arthroscopy. This confirms the authors' hypotheses. The mean magnitude of these differences [10 min (traction time) and 16 min (total surgery time)] is clinically important. This is important because increased traction (and total surgery) times have been directly correlated to an increased risk for complications.

Table II. Operative results

	<i>W and A</i>	<i>W and B</i>	<i>P-value</i>
Average overall surgical time (min)	118 ± 17	102 ± 13	<0.0001
Average traction time (min)	51 ± 18	41 ± 6	<0.0001
Average number of procedures (CPT codes) performed	5.5 ± 1.2	5.2 ± 1.4	0.12
Frequency of each performed procedure			–
Femoral cam osteochondroplasty	48	48	
Labral repair	48	48	
Capsular repair	48	50	
Pincer acetabuloplasty	39	23	
Acetabular chondroplasty	31	31	
AIIS subspine decompression	29	31	
Synovectomy	23	8	
Femoral head chondroplasty	4	3	
Lysis of capsulolabral adhesions	1	3	
Labral debridement	1	1	
Hip bursectomy	1	1	
Removal of hardware	1	2	
Loose body removal	0	1	
Stress radiographs	0	3	
Arthrogram	1	4	
Joint injection	0	1	
Average number of labral anchors used	3 ± 0.8	3.1 ± 0.9	0.32
Revision arthroscopy cases	1	2	–

AIIS, anterior inferior iliac spine; CPT, Current Procedural Terminology.

Early hip arthroscopy was performed with knee or shoulder arthroscopy instruments, which evolved into specialized hip arthroscopy instrumentation as the procedure became more common. Advancements include curved and flexible instruments and improved capsular management to increase instrument maneuverability [17]. Moreover, the 70° arthroscope improves joint visualization while reducing instrument crowding [18].

Prior studies have tried to mitigate the effects of traction via patient positioning as opposed to measures that reduce surgical or traction time. For example, traction time, traction force, perineal post modifications, postless techniques, fluid inflow rate and fluid pressure have all been studied in attempts to decrease hip arthroscopy complications [7–11]. One prior study evaluated two different types of radiofrequency ablation wands (plasma ablation versus standard ablation) during rotator cuff repair surgery and reported no difference in diathermy efficiency [19]. Both wands used in this study ablate tissue via a chemical process at the instrument tip, not a thermal process. The chemical process does not generate heat to pyrolyze tissue. Intraarticular fluid temperature is continuously displayed during the procedure, and an alarm is set to notify the surgeon if the temperature exceeds 45°C, which did not occur in either study group.

The present study suggests that the diameter difference between the two different bipolar radiofrequency ablation wands from the same manufacturer made a significant difference in total surgical and traction times. The authors speculate that for hip arthroscopy bipolar radiofrequency ablation instrumentation, given the same instrument angle, manufacturer and surgeon experience, increased efficiency of the Wand B over Wand A is likely from the larger surface area of the ablating surface (2.45 times larger), which may allow for the same amount of

work to be performed in less time and with less instrument maneuvers. Additionally, the increased shaft diameter increases the sturdiness of the instrument to facilitate adequate mobility of the instrument despite increased soft tissue superficial to the hip relative to other joints. Moreover, breakage of flexible instruments during hip arthroscopy is a reported complication, although rare [20–22]. Increased efficiency and decreased risk of breakage during arthroscopy of the deep hip joint are important characteristics for hip arthroscopy instrumentation. The authors suspect that the increased diameter of Wand B makes the instrument sturdier and easier to use during arthroscopy of the deep hip joint and when switching cannulas.

In the context of the learning curve for hip arthroscopy, these findings regarding hip arthroscopy instrumentation may have implications not only to actively practicing surgeons looking to decrease operative times but also to young surgeons who have not yet established routinely used instrumentation for their procedures. Furthermore, the present study could serve as a basis for future studies to investigate similar methods to decrease operative times and to guide future product design by manufacturers. Although bipolar radiofrequency ablation wand design may facilitate more efficient hip arthroscopy, wand selection is not a substitute for patient selection or surgical technique.

LIMITATIONS

A limitation of the present study is the retrospective design and inherent biases associated with data extraction from the electronic medical record. As the purpose of this simple investigation was simply a time analysis, no clinical outcomes were reported, including post-related complications or subjective patient-reported outcome scores. Another limitation is that only a single surgeon at a single center was utilized with the analysis

of only a small number ($n=2$) of a single company's instruments. An additional limitation is that this study does not report on the biomechanical properties of the wands (e.g. stiffness and durability). Intraarticular temperature was not recorded in the medical record and therefore was unavailable for the analysis in this investigation.

CONCLUSION

In this retrospective comparative investigation of 100 subjects that underwent routine hip arthroscopy, the use of a larger surface area wand was associated with significantly lower traction and surgical times. The mean magnitude of these differences [10 min (traction time) and 16 min (total surgery time)] is clinically important.

DATA AVAILABILITY

All original data from this investigation are freely available in a single dataset that may be furnished upon request.

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CONFLICT OF INTEREST STATEMENT

JDH: AAOS: Board or committee member; American Orthopaedic Society for Sports Medicine: Board or committee member; Arthroscopy: Editorial or governing board; Arthroscopy Association of North America: Board or committee member; DePuy, A Johnson & Johnson Company: Research support; International Society of Arthroscopy, Knee Surgery, and Orthopaedic Sports Medicine: Board or committee member; Orthopaedic Research Society: Board or committee member; PatientPop: Stock or stock Options; SLACK Incorporated: Publishing royalties, financial or material support; Smith & Nephew: Paid consultant, Research support; Thieme Medical Publishers: Publishing royalties, financial or material support; Xodus Medical: Paid presenter or speaker.

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