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Research article

Sexual and urinary function post-surgical treatment of femoroacetabular impingement: experience from the FIRST trial and embedded cohort study

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ABSTRACT

The goal of this study was to investigate the sexual and urinary function and any related complications in patients post-hip arthroscopy for the treatment of femoroacetabular impingement (FAI). Data from 214 patients enrolled in the FIRST trial and 110 patients enrolled in the trial's embedded prospective cohort study (EPIC) were analyzed. EPIC patients either refused to participate in the trial or did not meet the FIRST eligibility criteria. Outcomes included the International Consultation on Continence Questionnaire (ICIQ) for males (ICIQ-MLUTS) and females (ICIQ-FLUTS) and the Female Sexual Function Index (FSFI) and International Index of Erectile Function (IIEF) administered before surgery and at 6 weeks and 12 months. Urinary and sexual function adverse events were recorded up to 24 months. Linear regression analyses were conducted to compare the osteochondroplasty and lavage groups in the FIRST trial and to evaluate age and traction time as prognostic factors among all patients. Longer traction time was associated with a small but statistically significant improvement in urinary voiding function in males at 6 weeks and 12 months (MD (95% CI) = 0.25 (0.12, 0.39), $P < 0.001$ and 0.21 (0.07, 0.35), $P = 0.004$), respectively. Mean traction time was 43.7 (± 23.2) min for FIRST trial and 52.8 (± 15.2) min for EPIC cohort patients. Increasing age in male patients was associated with a decrease in urinary continence at 6 weeks (MD (95% CI) = 0.25 (−0.42, −0.09), $P = 0.003$). FIRST male patients who received osteochondroplasty improved significantly in sexual function at 12 months compared to males in the EPIC cohort (MD (95% CI) = 2.02 (0.31, 3.72), $P = 0.020$). There was an overall complication rate of 1.2% at 24 months [one urinary infection, two instances of erectile dysfunction (one transient and one ongoing at 24 months) and one reported transient numbness of tip of the penis]. Hip arthroscopy for the treatment of FAI has a low rate of sexual and urinary dysfunction and adverse events.

INTRODUCTION

Femoroacetabular impingement (FAI) is a painful condition of the young adult hip. Initially treated with open procedures [1], hip arthroscopy has taken over as the gold standard of treatment [2]. Due to a better understanding and improvement in arthroscopic technique and instrumentation, there has been a large increase in the number of hip arthroscopy procedures performed in the last 2 decades [3–7]. Prior randomized controlled trials (RCTs) have mostly demonstrated the benefits of surgery compared with physiotherapy for the treatment of FAI [8, 9]. The current arthroscopic treatment, known as osteochondroplasty, aims to correct the bony deformities characteristic of FAI and repair any soft tissue lesions such as labral tears [10, 11]. Multiple studies have reported low complication rates and deemed the osteochondroplasty procedure to be both safe and effective [12–15].

The hip is a relatively stable joint, and as such, a large amount of force is needed to distract the femoral head during surgery. Patients are typically placed on a traction table with a perineal post which helps by acting as a fulcrum to create the necessary distraction force. However, this traction can lead to perineal post-related complications, where the pudendal nerve can be

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injured by direct compression against the perineal post. Pudendal nerve injury is associated with sensory and sexual disorders [16] as well as lower urinary tract dysfunction [17]. Various studies have reported a rate of pudendal neuralgia of 1.8–27.6% after the use of traction tables for different procedures, including hip arthroscopy [16, 18, 19]. However, this complication is thought to be overlooked and underestimated [16] as some patients may not feel comfortable disclosing their symptoms. Furthermore, surgeons may not be questioning patients about these types of complications [18].

The Femoroacetabular Impingement Randomised controlled Trial (FIRST) compared arthroscopic osteochondroplasty versus arthroscopic lavage with or without labral repair in patients ages 18–50 years with FAI [15]. In tandem with the FIRST trial, we conducted an embedded prospective cohort study (EPIC) that evaluated FAI patients between the ages of 18–50 years who refused to participate in the trial or did not meet the FIRST eligibility criteria. All EPIC patients received the osteochondroplasty procedure. Patient follow-up was identical in both studies.

As part of the FIRST trial and EPIC cohort study, we collected gender-specific urinary and sexual function questionnaire outcomes at baseline, 6 weeks and 12 months, and any related adverse events up to 24 months. We present the results of these outcomes for the patients enrolled in both studies.

METHODS

Study design and patient selection

FIRST was a multi-centered RCT with patients enrolled from 10 sites in Canada, Finland and Denmark. A multi-center RCT, statistical analysis plan and primary results have been published [**15**, **20**, **21**]. The dataset from the FIRST trial, comprising 108 patients who were randomized to osteochondroplasty and 106 patients randomized to arthroscopic lavage and from the EPIC cohort, comprising 110 patients who received osteochondroplasty, were used in the current analysis. Patients in both the FIRST trial and EPIC cohort were administered urinary and sexual function questionnaires at baseline and 6 weeks and 12 months postoperatively and followed for any related adverse events up to 24 months. All surgeon investigators had fellowship training and performed a median of 100 hip arthroscopy procedures per year; the surgical technique was standardized, and well-padded perineal posts were used for all cases. As part of the standardization of the technique, the post was not removed for peripheral compartment work and air arthrogram and Trendelenburg positioning were also not used.

Outcomes

Urinary symptoms were evaluated with a gender-specific variation of the International Consultation on Continence Questionnaire (ICIQ)—the Male Lower Urinary Tract Symptoms Questionnaire (ICIQ-MLUTS) and the Female Lower Urinary Tract Symptoms Questionnaire (ICIQ-FLUTS). The ICIQ-FLUTS has three subscales, filling (scored 0 to 16), voiding (scored 0 to 12) and incontinence symptoms (scored 0 to 20). The ICIQ-MLUTS has two subscales, voiding (scored 0 to 20) and incontinence (scored 0 to 24). Each subscale is scored separately, where a lower score indicates a better urinary function for a given subscale [22–24].

Female and male sexual function was assessed with the Female Sexual Function Index (FSFI) and the International Index of Erectile Function (IIEF), respectively. The FSFI evaluates six domains of female sexual function: desire, arousal, lubrication, orgasm, satisfaction and pain [25]. The IIEF addresses male sexual function and has been shown to have high sensitivity and specificity and is validated for administration in research and clinical settings with five domains being evaluated: erectile function, sexual desire, orgasmic function, intercourse satisfaction and overall satisfaction [26–28]. As per the validated scoring instructions for both the FSFI and IIEF, a higher total score indicates better sexual function and if patients reported 'no sexual activity' for a question, the corresponding domain score was set to missing.

Urinary and sexual-related complications post-surgery were recorded as adverse events when reported by patients during follow-up to 24 months.

Statistical analysis

The score difference for each questionnaire was calculated from baseline to 6 weeks and 12 months per domain. Multiple linear regression was used to estimate the effect of osteochondroplasty versus lavage and impingement sub-type (i.e. Cam, Pincer or Mixed) on the change in urinary and sexual function between baseline and 6 weeks and 12 months in FIRST trial patients. Secondly, linear regressions were completed to estimate the effect of age and total traction time on the change between baseline and 6 weeks and 12 months in urinary and sexual function across both FIRST trial and EPIC cohort patients. All change scores were calculated and a positive value for the change score would indicate an improvement from baseline to follow-up. After observing outliers in our data, we performed robust regressions using MM estimation. Results from the robust regression models are presented as mean differences (MD) with corresponding 95% confidence intervals (CI) and *P*-values. We also present descriptive data using means and standard deviations ($\pm$). All tests were two-tailed with alpha = 0.05.

RESULTS

There was a total of 324 patients enrolled in the FIRST trial (214 patients) and EPIC cohort (110 patients). Our final analysis includes sexual function questionnaire outcomes for 47 females and 91 males at 6 weeks and 55 females and 88 males at 12 months; and urinary function questionnaire outcomes for 88 females and 132 males at 6 weeks and 81 females and 122 males at 12 months (Supplementary Table 1). The main reasons for non-respondents were: (I) in the case of the sexual function questionnaires if the patient reported 'no sexual activity' for a particular domain, it was set to missing; and (II) some patients refused to complete the sexual or urinary function questionnaires due to their sensitive nature. Patients from the FIRST trial were slightly older (mean 35.8 years $\pm$8.9 years) than patients in the EPIC cohort (mean 33.1 years $\pm$ 8.9 years). The demographics for patients with at least one completed urinary/sexual function questionnaire are provided in Table I.

There was a 97% follow-up rate for FIRST trial and a 96% follow-up rate for the EPIC cohort at 24 months for any adverse events. The MD for each change score from baseline to 6 weeks

Table I. Patient demographics and hip characteristics[a]

	FIRST Patients (141 patients)	*EPIC Patients (99 patients)*
Age in years, mean (SD)	35.8 (8.9)	33.1 (8.9)
Gender, *n* (%)		
Male	82 (58.2)	66 (66.7)
Female	59 (41.8)	33 (33.3)
BMI, *n* (%)		
Underweight <18.5	3 (2.1)	2 (2.0)
Normal weight 18.5 to <25	45 (31.9)	36 (36.4)
Overweight 25 to <30	53 (37.6)	50 (50.5)
Obese 30 to <40	37 (26.2)	11 (11.1)
Morbidly obese ≥40	3 (2.1)	0 (0.0)
Tonnis and Heinecke classification, *n* (%)		
Grade 0	73 (51.8)	24 (24.2)
Grade 1	62 (44.0)	56 (56.6)
Grade 2	6 (4.3)	17 (17.2)
Grade 3	0 (0.0)	2 (2.0)

[a]Includes 240 patients who contributed to at least one of the regression models above (i.e. has at least one 6 week or 12 month urinary or sexual functioning score and corresponding baseline score).

and 12 months for each treatment group is presented in Table II. There were 2 urinary/sexual dysfunction events reported among those that received osteochondroplasty: one resolved urinary tract infection in a female at 24 months and one case of erectile dysfunction in a male diagnosed 3 months after surgery and resolving 4 months later; and 2 events among those that received arthroscopic lavage: one male patient reported persistent numbness on the tip of the penis at 6 months, resolving at 10 months and another male patient reported erectile dysfunction at 3 months that was still ongoing after the 24-month follow-up.

Results from the regression analyses

FIRST trial patients

The results of the multiple linear regression for the FIRST trial patients (osteochondroplasty versus lavage), showed no difference from baseline to 6 weeks and baseline to 12 months in both urinary and sexual function for either males or females (Table II).

FIRST trial and EPIC cohort patients

Based on data from both the FIRST trial and EPIC cohort patients, longer traction time was associated with a statistically significant improvement in urinary voiding function in males at both 6 weeks and 12 months (MD, 95% CI = 0.25 (0.12, 0.39), $P < 0.001$ and 0.21 (0.07, 0.35), $P = 0.004$ per 10-min increase in traction time, respectively). Mean traction time was 48 (±21.1) min in the FIRST trial osteochondroplasty group and 39.2 (±24.5) min in the lavage group. For the EPIC cohort, the mean traction time was 52.8 (± 15.2) min. There was an association with a statistically significant decrease in urinary continence at 6 weeks in older males (MD, 95% CI = -0.25 (−0.42, −0.09) per 10-year increase in age, $P = 0.003$) but not by 12 months. In addition, FIRST trial male patients who received osteochondroplasty improved significantly in sexual function at 12 months when compared to the patients who received osteochondroplasty as part of the EPIC cohort (MD, 95% CI = 2.02 (0.31, 3.72), $P = 0.020$). All other questionnaire domains showed no significant difference from baseline to 6 weeks or 12 months for traction time, patient age or treatment group (Supplementary Table 2).

DISCUSSION

The main findings from this study are, first, the urinary and sexual adverse event rate is low (4/324, 1.2%). Second, a substantial number of patients did not complete all or part of the urinary and sexual function questionnaires and potentially report any related complications, where 25.4%–39% of females did not complete either the ICIQ-FLUTS or FSFI and 35.4%–43.7% of males did not complete the ICIQ-MLUTS or IIEF at each time point. Our regression analyses found a statistically significant impact of the following prognostic factors: (i) among males, increasing age led to a higher risk of incontinence symptoms at 6 weeks post-surgery; (ii) male patients who received osteochondroplasty in the FIRST trial had a better sexual function at 12 months than patients who received osteochondroplasty in the EPIC cohort; and unexpectedly, (iii) male patients had better urinary voiding

Table II. Multiple linear regression model for mean difference between baseline and 6 weeks and 12 months for the FIRST trial patients comparing arthroscopic osteochondroplasty versus lavage

	6 Weeks		*12 Months*	
	MD (95% CI)	*P-value*	*MD (95% CI)*	*P-value*
ICIQ-FLUTS				
Filling	0.37 (−0.33, 1.08)	0.297	0.44 (−0.39, 1.27)	0.300
Voiding	0.02 (−0.45, 0.48)	0.941	0.13 (−0.34, 0.59)	0.591
Incontinence	0.30 (−0.27, 0.87)	0.300	0.007 (−0.83, 0.84)	0.987
ICIQ-MLUTS				
Voiding	−0.04 (−0.89, 0.80)	0.920	−0.61 (−1.45, 0.24)	0.161
Incontinence	−0.27 (−0.74, 0.20)	0.263	−0.16 (−0.58, 0.25)	0.438
FSFI				
Total score	1.18 (−2.09, 4.45)	0.480	−2.12 (−4.52, 0.28)	0.083
IIEF				
Total score	0.57 (−1.22, 2.37)	0.531	1.58 (−0.32, 3.47)	0.103

function scores with a longer traction time at both 6 weeks and 12 months.

Dippman *et al.* reported a similarly low urinary/sexual dysfunction event rate in a study evaluating 50 patients receiving FAI surgery, with only one patient reporting erectile dysfunction that resolved after 7 weeks (1/50, 2%) [29]. In another study evaluating 100 patients who received hip arthroscopy with traction for the treatment of FAI and any labral or chondral pathology, the incidence of pudendal nerve injury was 9% (9/100) [30]. The authors noted that some patients experienced erectile dysfunction but did not differentiate these events from perineal numbness. Pudendal nerve injury is a commonly reported complication after hip arthroscopy [17, 19] but it is usually transient and its diagnosis is often not clearly defined, or patients are only asked about perineal sensations [18]. While this low incidence of sexual and urinary events advocates for the safety of hip arthroscopy, physicians should not overlook these symptoms and go beyond the 'simple' perineal numbness questionnaire. Also, patients should be counselled pre-operatively about these types of possible complications and encourage post-operative reporting to help improve patient recovery and quality of life.

Prior literature has posited that the incidence of sexual and urinary complications post-hip arthroscopy is underreported, either because patients do not feel comfortable discussing these symptoms or because surgeons simply do not ask about them [18]. Our findings corroborate this idea where over 24% of patients did not complete their urinary or sexual questionnaire. We expect this was due to both the sensitive nature of the questionnaires being administered and the required scoring method (i.e. to set domains to 'missing' when one or more questions did not apply to a patient). Pre-operative counselling and the patient–surgeon relationship are of utmost importance to gain patient trust and to then be able to solicit this delicate information in order to offer better treatment.

Traction time during hip arthroscopy and its impact on urinary and sexual dysfunction has been under investigation for many years, but results are still conflicting. Many studies have not found traction time to be a factor [16, 29–31], while others have found an association between longer traction time and the risk of postoperative complications [32, 33]. Recently more focus has been put on traction force rather than time. An experimental study has estimated that a force equivalent to 200 pounds is required for initial distraction [34]. Fortunately, venting techniques have reduced this to approximately 50 pounds [34, 35] to limit the traction force, and presumably, the amount of pudendal nerve-related complications (13–15). In our study, while traction force was not investigated, surprisingly, male patients who had longer traction time had significantly better voiding function postoperatively. This result was consistent at both the 6-week and 12-month time points. It is possible that patients may have benefitted from our experienced recruiting centers that have specialized anesthesiologists. Ledowski *et al.* have found that neuromuscular paralysis during hip arthroscopy only reduced the perineal force by 5 g/cm^2 for a mean maximal pressure of 2540 g/cm^2. While this was a small reduction, they found that male patients had significantly greater joint width than female patients after neuromuscular paralysis (6.8% versus 2.8%, respectively), concluding that males benefit more from neuromuscular paralysis [36].

However, three out of four of our adverse events were in male patients. Ellenrieder *et al.* found that male patients required greater force than female patients (517 N versus 444 N) during hip arthroscopy, but it is unclear if the additional force contributes to urinary and sexual dysfunction post-surgery [37]. While this could be one possible explanation, it is also important to consider that the minimally clinically important difference (MCID) for the ICIQ-MLUTS questionnaires has not been calculated yet, and we might expect that a MD of 0.25 in this regard is likely not clinically significant.

Another finding of this study is that male patients who received osteochondroplasty from the FIRST trial had better sexual function postoperatively than patients in the EPIC cohort. Sexual limitation in FAI patients because of the hip's restricted range of motion has been noted in the past [38]. Recently, Morehouse *et al.*in their model of sexual positions in males and females noted that males had more positions at risk of instability and impingement after hip arthroscopy for FAI treatment with capsular closure than females [39]. Also, Raut *et al.* surveyed 120 female patients who had hip arthroscopy for labral repair and found that 94% of sexually active patients had pain before surgery and 89% had improvement post-surgery but still suffered some discomfort [40]. The sexual function questionnaires used in this study (IIEF, FSFI) focus mainly on satisfaction with sexual intercourse and genital-related symptoms, but do not specifically ask about hip pain during sex. While the position aspect and hip pain during sexual intercourse may have been an avenue to explain the difference we found between osteochondroplasty patients in FIRST and EPIC, prior analysis has shown that there are no differences between FIRST and EPIC patients with respect to hip pain, hip function and health-related quality of life postoperatively [41]. We expect that the small sample size and the MD showing only a 2-point difference means this finding is likely not clinically significant.

Older male patients suffered more incontinence symptoms at 6 weeks. However, the MD was only −0.25 points, and thus as mentioned earlier, it is a minimal difference and is unlikely to be clinically significant. Still, prior research has demonstrated that older patients have a higher prevalence of incontinence [42] so this could explain that the same 'perineal trauma' has a larger effect on bladder function in older patients.

There are some limitations to this study. As previously discussed, the total sample size for each of the presented outcomes was reduced to approximately 50% initially as each outcome is gender specific, not to mention that 24.5%–43.7% of patients did not complete some or all of the questionnaires at either follow-up visit. This likely resulted in underreporting of urinary and sexual dysfunction, as well as any related adverse events. In addition, we solely focused on sexual and urinary dysfunction and did not mandate surgeons to specifically seek perineal numbness symptoms, unless the patient chose to report it. . Another limitation is that the questionnaires used are not validated in either Finnish or Danish (except for IIEF [26]), although they have shown validity in other cultures and all questionnaires were translated and tested for face validity before the start of the trial [43–48]. There is no clear explanation as to why male patients in our study had

statistically significantly improved urinary function with longer traction time or why male patients who received osteochondroplasty as part of the FIRST trial appeared to have a better sexual function at 12 months when compared to the EPIC cohort patients. As previously mentioned, we do not expect these findings to be clinically significant. Lastly, expertise bias may play a role in the generalizability of our results given that participating centers and surgeons are high volume surgeons adept at patient positioning, ensuring appropriate perineal padding, and involving anesthesiologists proficient in muscle paralysis and therefore, potentially limiting the overall number of adverse events.

Major strengths of this study are the use of objective and validated instruments to assess more than 300 patients regarding urinary and sexual dysfunction up to 12 months. The external validity of the study is also important as there were 10 sites worldwide that participated.

CONCLUSION

The incidence of sexual and urinary adverse events post-arthroscopic FAI surgery is low and the procedure does not appear to significantly impact long-term urinary and sexual function. Practitioners should be aware of these complications and start the discussion with patients early in the pre-operative setting to gain trust and better manage post-operative symptoms.

DATA AVAILABILITY

The data underlying this article are available in the article and its online supplementary material.

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SUPPLEMENTARY DATA

Supplementary data are available at *Journal of Hip Preservation Surgery* online.

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CONFLICT OF INTEREST STATEMENT

None declared.

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