Return to Driving After Hip Arthroscopy

A Systematic Review and Meta-analysis

Roy Assaf,* MD, Ilan Mitchnik,* MD, Yiftah Beer,* MD, Gabriel Agar,* MD, Eran Tamir,* MD, Dror Lindner,* MD, and Ron Gilat,*† MD

Investigation performed at Shamir Medical Center and Tel Aviv University, Tel Aviv, Israel

Background: Hip arthroscopy is an increasingly common procedure; however, recommendations for safely returning to driving after hip arthroscopy vary among surgeons.

Purpose: To systematically review and analyze the current available evidence on the optimal time to safely return to driving after hip arthroscopy.

Study Design: Systematic review; Level of evidence, 3.

Methods: A systematic review and meta-analysis was performed in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Two authors independently conducted a literature search throughout August 2021 using the PubMed, Google Scholar, Embase, and Cochrane databases. A total of 1425 articles were reviewed, and 5 articles were included. All included articles used brake reaction time (BRT) as an observer-reported outcome measure. A meta-analysis was performed to compare pre- and postoperative BRT values. Study sample sizes and mean BRT values were collected per each included study. First, data were analyzed for the right and left hips combined; then, a subgroup analysis stratified by laterality was performed. The BRT values were divided according to time periods of measurement: preoperatively and 2, 4, 6, and 8 weeks postoperatively.

Results: The included studies evaluated safety to return to driving after hip arthroscopy in 160 patients. Of these, 142 patients were treated for femoroacetabular impingement, while 18 patients underwent hip arthroscopy for other diagnoses. The mean weighted age was 33.7 ± 9.0 years, 47.5% of the patients were female, and the right hip was affected in 71.2%. The preoperative range of BRT was 566 to 1960 ms, and postoperative BRT range was 567 to 1840 ms at 1 to 2 weeks and 523 to 1860 ms at 3 to 12 weeks. Meta-analysis found the studies to be moderately heterogenic (P = .06). There were no statistically significant differences in BRT between the preoperative period and at 2, 4, 6, and 8 weeks postoperatively.

Conclusion: Return to driving is likely safe as early as 2 to 4 weeks after right-sided hip arthroscopy, and 2 weeks after a left-sided procedure, as driving performance returns to the preoperative level.

Registration: CRD42021274460 (PROSPERO identifier).

Keywords: femoroacetabular impingement; hip arthroscopy; hip; drive; return to driving

Driving is a complex task that requires integrity of both motor and sensory control.40 The investigation of driving safety is multifactorial and difficult to measure.40 Besides driving performance measures, other factors such as pre-surgical driving ability, laterality of surgery, use of postoperative bracing, opioid medication consumption, and type of vehicle transmission (automatic or manual) should be taken into consideration.19

For lower extremity procedures, brake reaction time (BRT) is considered to be the most important driving performance measure for the prediction of safety to return to driving after orthopaedic surgery.30 BRT is defined by the time between a visual stimulus and the application of pressure on the brake pedal (Figure 1).16,19

The average “normal” BRT of nonoperative drivers (healthy drivers without previous surgery) varies from 250 to 1360 ms,15 while a BRT <700 ms is considered the “safe zone” when the driver is anticipating a braking stimulus in a driving simulator.32 In real-time events, when stimulus is not anticipated, a BRT of 1250 to 1500 ms may be considered normal.22 Many studies evaluate BRT as a measure for safe return to driving after orthopaedic procedures, among them knee arthroplasty,13,23 hip arthroplasty,2,37 anterior cruciate ligament reconstruction, and knee arthroscopy.38,42

Hip arthroscopy was first described in 1931 by Burman,6 to visualize joints in a cadaveric model. However, it did not gain popularity as a treatment modality until the late...
Since then, the utilization of hip arthroscopy increased dramatically, with a 364% increase in the annual rate between the years 2005 and 2013 in the United States, while the largest increase was observed in young age groups. Hip arthroscopy is indicated for a variety of clinical conditions such as femoroacetabular impingement (FAI), acetabular labral tears, focal cartilage injury, loose bodies, and ligamentum teres pathologies.

Patients often ask their physician when they can safely return to driving after orthopaedic surgery. A survey of the American Automobile Association found that 87.5% of driving-age Americans drove an average of 47.1 minutes daily, at least occasionally. With the improvement in hip arthroscopic techniques and outcomes, patients continue to raise their expectations for early recovery and expedited return to normal activities. Information about a realistic time frame for being able to drive safely again should be part of preoperative counseling by the treating physician, considering the medical and legal implications of this decision and based on the best and most up-to-date available literature.

Return to driving after hip arthroscopy is a subject of increased interest, with numerous studies published in recent years. The aim of this systematic review and meta-analysis was to assess current available evidence on return to driving after hip arthroscopy, with the purpose of being able to make evidence-based decisions on the optimal time to return to driving after surgery, in a way that will not compromise patient safety.

METHODS

A systematic review and meta-analysis was performed in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The protocol of the study was formulated before data extraction and was registered to a prospective database.

Search Strategy

Two authors (R.A., I.M.) independently conducted a literature search throughout August 2021, using the following databases: PubMed, Google Scholar, Embase, and the Cochrane Central Register of Controlled Trials. The keywords utilized for the search were (“drive” or “driving” or “brake time”) and (“hip” or “arthroscopy”), with the purpose of ideally capturing all relevant articles that primarily evaluate driver safety or time to return to driving after hip arthroscopy.

Study Selection

Inclusion criteria were formulated using the Population Intervention Comparison Outcomes approach: population—general adult human population (18 years or older) undergoing hip arthroscopy and in possession of a driving license; intervention—hip arthroscopy, on either the right or left side; comparators—preoperative baseline or control cohort; outcomes—the primary outcome measured was BRT, and the secondary outcomes were other drive performance parameters (ie, total brake time [TBT] and initial reaction time [IRT]).

Only published studies were selected for inclusion, if they presented with clear evidence about observer-reported outcome measures. Excluded from eligibility were studies reported in non–English language, abstract-only articles, commentaries, and letters to the editor.

Data Extraction

The literature search was uploaded to a reference management software (Zotero) to facilitate collaboration among reviewers and the management of duplicates. After the initial search and duplicate subtraction, titles were screened and abstracts were reviewed. Full texts were obtained for titles that met the inclusion criteria or where there was any uncertainty. The extraction of data was performed by 2 independent authors (R.A., I.M.), and a cross-check for accuracy was made. If there was any disagreement regarding the inclusion of a specific article, one of the senior authors (R.G.) was consulted.

The following data were recorded: (1) study details: study design and type, trial size, duration of follow-up and frequency of assessment, simulator design (manufacturer), publication status, and level of evidence; (2) study population: mean age, sex, and laterality of surgery; (3) type of surgery; (4) control group details; (5) methods of evaluation; and (6) results and recommendations.

To ensure literature saturation, the authors scanned the reference lists of included studies or relevant reviews identified through the search.

Methodological Assessment

The methodological quality for included studies was assessed by 2 authors (R.A., I.M.) using the methodological index for non-randomized studies score. The ideal scores are 16 and 24 for noncomparative and comparative studies, respectively. The level of evidence was attributed using the Oxford Centre for Evidence-Based Medicine scale.

†Address correspondence to Ron Gilat, MD, Department of Orthopaedic Surgery, Shamir Medical Center and Tel Aviv University, Tel Aviv, Israel (email: ron.gilat@gmail.com).

*Department of Orthopaedic Surgery, Shamir Medical Center and Tel Aviv University, Tel Aviv, Israel.

D.L. and R.G. contributed equally to this study and share final authorship. D.L. and R.G. contributed equally to this study and share final authorship. Final revision submitted April 16, 2022; accepted July 25, 2022.

The authors declared that they have no conflicts of interest in the authorship and publication of this contribution. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.
Quantitative Analysis

Data for study sample sizes, mean BRT in milliseconds, and standard deviation for BRT were collected per each included study into a Microsoft Excel 2019 spreadsheet. Mean BRT and standard deviation were first combined for both the right and the left hips when they were reported separately. This was done for 2 reasons. First, one of the included studies, that by Yoshida et al., did not report separate results stratified by hip laterality, which would mean the loss of 21 patients for analysis. Second, Balazs et al. was the only study to report leg dominance preoperatively, while other studies did not adjust for this confounding factor. When necessary data were missing, we contacted the corresponding authors for data recovery. Calculations for combined mean BRT, standard deviation, and missing standard deviation data were imputed according to the Cochrane Handbook.

We chose to use a correlation coefficient of 0.80 for the combined standard deviation calculations. The mean BRT and standard deviation were then divided according to time periods of measurement: preoperatively and at 2, 4, 6, and 8 weeks postoperatively. These periods were selected based on being the most commonly used time periods in the studies we included.

The data were then analyzed using Review Manager (RevMan) Version 5.4 (Cochrane). First, we analyzed data for the right and left hips combined, and afterward, we performed a subgroup analysis for each side separately. We measured our effect sizes based on a standardized mean BRT difference weighted by inverse variance. Studies were considered heterogeneous based on differences in methodology ranging from patient selection, laterality of the operated hip, and operative technique. Therefore, we chose to use a random-effects model. Heterogeneity was measured using the $I^2$ statistic. Alpha for the $P$ value was set at .05.

RESULTS

The initial search resulted in 1425 articles. After duplicate removal, screening, and the addition of 2 articles identified from references, 7 studies were assessed against the inclusion criteria and 2 articles were excluded for being abstract-only publications. The PRISMA flowchart is presented in Figure 2.
Five articles were included per criteria. Three, 24, 34, 45, 46 Four studies were of prospective case-control cohorts (evidence level 2) 3, 24, 34, 45 and 1 of a prospective cohort (evidence level 3). 46 Included studies were published between the years 2017 and 2021.

Qualitative Analysis

Overall, the studies included 160 patients. Of these, 142 patients were treated for FAI, and 18 patients had undergone other “simple” hip arthroscopic procedures (“simple”—defined by authors as <60 minutes in duration, without osteous correction or labral repair) (detailed in Table 1). 24 The mean weighted age was 33.7 ± 9.0 years, 47.5% of the patients were female, and the right hip was affected in 71.2%. Laterality was not reported in the 59 patients of Balazs et al 3 and 21 patients of Yoshida et al. 6 We contacted the corresponding authors to recover these data, and the authors kindly provided the requested information. Patient characteristics are reported in Table 2.

All studies included BRT as an outcome measure. The preoperative range of BRT was 566 to 1960 ms. The postoperative range at 1 to 2 weeks was 563 to 1840 ms, and at 3 to 12 weeks, 523 to 1860 ms. All studies also used at least 2 methods of evaluation. Turn reaction time, throttle release time, gas off time, release time, IRT, brake travel time, and sit-to-stand test (STST) were reported by 1/20 study each. Foot movement time (FMT), brake pedal depression, and TBT were reported by 2 studies each. Table 3 summarizes the outcomes measured, results, and recommendations per study. A description of surgical details per study is described in Table 1.

Most studies found that driving performance returns to the preoperative level as early as 2 weeks after right- or left-sided hip arthroscopy for FAI and after 1 week for other right-sided hip arthroscopic procedures (Table 3). One exception was Balazs et al, 3 who found that patients after right-sided hip arthroscopy for FAI had prolonged BRT until 4 weeks after surgery, while driving performance after left-sided hip arthroscopy showed no impairment.

The study by Yoshida et al 46 was the first to compare driving performance in patients with and without capsular repair. They found no significant effect of capsular repair on any of the driving variables postoperatively.

Two studies 45, 46 that evaluated patients’ laterality of surgery found no difference in postoperative driving

| Lead Author (Year) | Sample Size | Procedure Type | Procedure Details (No. of Patients) |
|--------------------|-------------|----------------|-----------------------------------|
| Yoshida (2021) 46 | 21          | FAI            | 48% capsular repair; 95.2% labral repair |
| Jo (2020) 24      | 47          | FAI: 29; other hip arthroscopy: 18 |
|                   |             | Labral repair with osteoplasty (8), labral repair with osteoplasty + iliopsoas release (3), labral repair + iliopsoas release (1), iliopsoas release (1), labral debridement with osteoplasty (1) |
|                   |             | Labral repair with osteoplasty (8), labral repair with osteoplasty + iliopsoas release (3), labral repair + iliopsoas release (1), iliopsoas release (1), labral debridement with osteoplasty (1) |
| Balazs (2018) 3    | 59          | FAI            | Osteochondroplasty + labral repair |
| Vera (2017) 45     | 19          | FAI            | Labral repair, femoroplasty, acetabuloplasty, and capsular repair |

FAI, femoroacetabular impingement.

### Table 1

| Lead Author (Year) | Study Design | Method of Evaluation | Age, y, mean ± SD | % Female | Laterality of Surgery | LOE | MINORS Score |
|--------------------|--------------|----------------------|-------------------|----------|----------------------|-----|--------------|
| Yoshida (2021) 46 | Prospective  | Driving simulator (response, Vericom Computers Inc) | 31.1 ± 9.3 | 52.3 | 10 R, 11 L | 3 | 12 |
| Jo (2020) 24      | Prospective case-control | Driving simulator (Carnetsoft BV) | 36.2 ± 7.9 | 36.0 | All R | 2 | 21 |
| Momaya (2018) 34  | Prospective case-control | Driving simulator (System Technology Inc) | 27.3 ± 9.1 | 78.5 | All R | 2 | 19 |
| Balazs (2018) 3    | Prospective case-control | Driving simulator (DriveSafety) | 33.7 ± 8.1 | 45.7 | 32 R, 26 L | 2 | 20 |
| Vera (2017) 45     | Prospective case-control | RT-2 S reaction time tester (Advanced Therapy Products) | 34.9 ± 11.3 | 52.6 | 10 R, 8 L | 2 | 21 |

L, left; LOE, level of evidence; MINORS, methodological index for non-randomized studies; R, right; RT-2 S, Reaction Time-2 S.

One patient was dropped from brake reaction time analysis.
parameters between right and left hips in comparison with the preoperative baseline.

Vera et al demonstrated a significant correlation between BRT and the STST in the first 6 weeks after surgery. It was also the only study to check STST.

Two studies demonstrated that the driving performance of patients with painful hips awaiting surgery is comparable with that of the control groups. In contrast, 2 other studies demonstrated adverse baseline driving parameters in the patient groups compared with the control groups.

Quantitative Analysis of BRT

The analysis found the studies to be insignificantly moderately heterogeneous \((k = 5; I^2 = 38\%; P = .06)\), as shown in Figure 3. Our analysis showed no statistically significant differences in BRT between the preoperative and postoperative periods for the weeks analyzed. Although there was an insignificant trend for slower BRT 8 weeks postoperatively, a funnel plot showed that this was likely due to publication bias (Figure 4).

A separate subgroup analysis adjusted for the 2 operated sides found no statistically significant changes in the mean BRT difference across all time periods. The right hip meta-analysis \((k = 5)\) found an overall mean BRT difference of \(-0.16 (95\% CI, -0.37 to 0.05; I^2 = 0\%; P = .77)\). When compared with the preoperative values, the mean BRT differences were \(-0.00 (95\% CI, -0.38 to 0.37; I^2 = 0\%); P = .87\) at 2 weeks postoperatively, \(-0.23 (95\% CI, -0.73 to 0.27; I^2 = 37\%; P = .20)\) at 4 weeks postoperatively, \(-0.08 (95\% CI, -0.55 to 0.40; I^2 = 0\%; P = .91)\) at 6 weeks postoperatively, and \(-0.42 (95\% CI, -0.95 to 0.10; I^2 = 0\%; P = .58)\) at 8 weeks postoperatively.

For the left hip, only data available from Vera et al, Balazs et al, and Yoshida et al were included. The left hip meta-analysis \((k = 3)\) found an overall mean BRT difference of \(-0.16 (95\% CI, -0.37 to 0.05; I^2 = 0\%; P = .77)\). When compared with the preoperative values, the mean BRT differences were \(-0.00 (95\% CI, -0.38 to 0.37; I^2 = 0\%; P = .87)\) at 2 weeks postoperatively, \(-0.23 (95\% CI, -0.73 to 0.27; I^2 = 37\%; P = .20)\) at 4 weeks postoperatively, \(-0.08 (95\% CI, -0.55 to 0.40; I^2 = 0\%; P = .91)\) at 6 weeks postoperatively, and \(-0.42 (95\% CI, -0.95 to 0.10; I^2 = 0\%; P = .58)\) at 8 weeks postoperatively.

DISCUSSION

The main finding of this systematic review and meta-analysis is that 4 of the included studies recommended return to driving at 2 weeks after hip arthroscopy for FAI, regardless of laterality. In contrast, the largest cohort in our meta-analysis suggested a return to driving at 4 weeks after right-sided hip arthroscopy for FAI.3

Meta-analysis of BRT showed no significant differences between pre- and postoperative measurements at 2, 4, 6, and 8 weeks, meaning that BRT returns to baseline as early as 2 weeks after right- or left-sided hip arthroscopy. Our findings are supported by 2 articles that were not included in our study because they are abstract-only papers. Kwapisz et al performed a prospective case-control study that analyzed 14 patients who underwent right-sided hip arthroscopy for the management of FAI. The study showed no significant differences between pre- and postoperative BRT and recommended return to driving 2 weeks after right-sided hip arthroscopy for FAI. The same results were obtained by Rounds et al, who performed a 2-week follow-up prospective cohort study with a
sample of 4 patients with right-sided and 4 with left-sided hip arthroscopies (without mention of surgery type). In another study that was included in this review, Jo et al.\textsuperscript{24} analyzed 18 patients who underwent other types of hip arthroscopies (Table 1) and found that BRT returned to preoperative levels 1 week after surgery.

The ability to drive safely requires an efficient reaction time, from initiation of stimulus ordering to brake, to foot movement off the accelerator and initial contact with the brake pedal. Thus, BRT is commonly used in the literature to assess time to return to driving after orthopaedic surgery\textsuperscript{16,19,37} and prioritized by the American Automobile Association as one of the most important parameters for the determination of driving capability.\textsuperscript{14} The BRT has 2 components (IRT and FMT) and can be calculated by combining them (Figure 1). IRT is defined as the time measured from initial stimulus to initiation of foot movement off the accelerator. FMT is defined as the time measured from initiation of foot movement off the accelerator to initial contact with the brake pedal.\textsuperscript{19} FMT depends on the amount of pain experienced, range of motion, and immobilization devices.\textsuperscript{19} On the other hand, IRT relies on neurologic integrity with factors such as alertness, visual acuity, and hearing. Patients experience pain in the acute postoperative period, and this could influence BRT by prolonging FMT. Most of the included studies in our review\textsuperscript{3,24,34} tracked patients’ pain scores before driving simulation sessions using the visual analog scale (VAS). Jo et al.\textsuperscript{24} and Balazs et al.\textsuperscript{3} found no significant correlation between changes in braking parameters and VAS in the postoperative period, meaning that changes in postoperative pain score did not influence driving performance.

The use of opioid medications in the acute postoperative period is common and can alter alertness, influencing BRT by prolonging IRT. Most of the included studies\textsuperscript{24,34,46} tracked patients’ pain scores before driving simulation sessions using the visual analog scale (VAS). Jo et al.\textsuperscript{24} and Balazs et al.\textsuperscript{3} found no significant correlation between changes in braking parameters and VAS in the postoperative period, meaning that changes in postoperative pain score did not influence driving performance.

**Figure 3.** Forest plot of comparison of changes in brake reaction time (BRT) after hip arthroscopy. PreOP, preoperative; PostOP, postoperative; PostOP2, 2 weeks postoperative; PostOP4, 4 weeks postoperative; PostOP6, 6 weeks postoperative; PostOP8, 8 weeks postoperative; IV, inverse variance; SD, standard deviation; Std., standardized.
Refined from prescribing opioid medications several days or the morning before driving simulation sessions. Balazs et al tracked the use of analgesic medications prescribed per each driving session and found no association between changes in braking parameters and the use of postoperative opiate analgesics. This finding is in accordance with other studies that evaluated driving ability and safety after intake of opioid analgesics. However, considering that some patients undergo a significant increase in the dose of opioids in the acute postoperative period, significant cognitive impairment is likely to occur for 1 week after intake, as demonstrated by a study from 1989.

Driving simulators are a common method for the evaluation of driving performance after orthopaedic surgery, as they try to replicate real-life driving experience. However, these tools are expensive and rarely used in the clinical settings. Thus, the evaluation of braking parameters may benefit from other alternative, cheap, and easy-to-apply methods. Vera et al demonstrated a significant correlation between BRT and the STST in the first 6 weeks after surgery. As described by the authors, the STST measures the number of times a patient can rise from a sitting to a standing position in 10 seconds. This correlation is important, as this simple test can be applied by any caregiver and in any clinical setting and has the potential to be used as an alternative for the costly driving simulators.

Surgery intervention of the hip joint may significantly alter driving parameters by causing pain and decreasing range of motion. A recent meta-analysis performed by Patel et al demonstrated a return to baseline of BRT at 6 weeks postoperatively after total hip arthroplasties. This observation may be attributed to the open surgical technique, which may carry greater injury to soft tissues. Hip arthroscopy is a minimally invasive procedure that offers minimal damage to soft tissues.

Several studies have demonstrated superior clinical outcomes of arthroscopic capsular repair versus capsulotomy without repair. Aware of these results, Yoshida et al hypothesized a faster return to baseline for driving parameters after capsular repair, considering the capsule’s role in joint stabilization, proprioception, and pain modulation. Of Yoshida’s study cohort, 48% underwent capsular repair, but no significant differences were found in pre- and postoperative BRT between the 2 groups. Considering the small sample size of this study, further investigation of the capsular repair effect on driving parameters is warranted.

Additionally, there is significant variability among hip arthroscopic surgeons in postoperative rehabilitation protocols in terms of weightbearing and hip bracing protocols. While immediate weightbearing as tolerated may be recommended for some interventions, others require 6 weeks of partial or no weightbearing. Postoperative braces are commonly used to immobilize and protect the joints after lower extremity procedures. They act by limiting range of motion, can be less or more restrictive, and can potentially affect driving safety measurements. The updated literature has little available data on the effect of postoperative weightbearing restrictions and hip bracing on driving parameters and recommendations for return to driving. Some studies have demonstrated a return to baseline of driving parameters 6 weeks after initiation of full weightbearing. Current available data suggest that hip braces do not impair BRT, while a significant impairment is demonstrated with right-aided range of motion restricting knee and ankle braces.

Besides the physicians' role in determining a time frame for return to driving after surgery, local or national government agencies have their own regulations and recommendations, which vary among different countries. This could further influence and confound the optimal time to safely return to driving in different states.

**Limitations**

The main limitation of our study is the relatively limited sample size of the included studies. A priori calculation of sample size by Jo et al determined that in order to detect a difference of 150 ms in BRT with 80% power, a minimal sample size of 20 patients per group was needed. Vera et al had a cohort of 19 patients, while Momaya et al had a cohort of only 14 patients. Vera et al and Yoshida et al, who investigated the differences of BRT between right and left hips, also demonstrated a small sample size per each group (see Table 2). A small sample size was also reported in the 2 groups of patients in whom capsular repair was evaluated, in the study performed by Yoshida et al.

Another important limitation consists of heterogeneity between the included studies due to differences in outcomes measured, study population and design, methodology, rehabilitation protocols, and type of surgery. For example, while endpoint BRT in most studies was determined as the initial contact with the brake pedal, Yoshida et al set the endpoint to 5° depression of the brake pedal, and Momaya et al obtained significantly higher pre- and postoperative BRT measurements in confront to all other studies included, indicating potential differences in methodology. However, the same recommendations for driving reported by most studies were obtained by Momaya et al after evaluation of changes in
pre- and postoperative BRT. In contrast to all included studies, Vera et al included the different postoperative weightbearing and bracing protocols. While 3 studies instructed the patients to partially bear weight for several weeks, others permitted weightbearing as tolerated from the immediate postoperative period. Only 1 study clearly stated the avoidance of hip bracing during simulator testing, while another reported that patients were allowed to remove their brace during driving testing but did not provide further information. We contacted the authors for some clarifications. Momaya et al did not strictly recommend any postoperative hip bracing protocols to their patients and required the removal of braces before driving simulator testing. In contrast, Vera et al did recommend hip bracing for 3 to 4 weeks postoperatively and required their removal before testing. As for heterogeneity of surgery type, the included studies performed different types of arthroscopic procedures for the treatment of FAI (see Table 1) but did not provide information about BRT measurements per each separate procedure. Moreover, Jo et al included 18 patients who had undergone hip arthroscopy for other diagnoses. This resulted in the categorization of hip arthroscopy as “1 pathology” and could result in premature or delayed return to driving recommendations for certain procedures.

Finally, the braking parameters in the studies included were measured with anticipated stimuli and are therefore substantially lower than braking parameters with nonanticipated stimuli; this difference could differ by hundreds of milliseconds. Given the awareness and anticipation for stimuli by all patients included, it is probable that driving simulators do not effectively replicate real-life driving experience, and evaluation for changes in BRT should be made only by confronting pre- and postoperative measurements.

CONCLUSION

Return to driving is likely safe as early as 2 to 4 weeks after right-sided hip arthroscopy, and 2 weeks after a left-sided procedure, as driving performance returns to the preoperative level. Additional high-quality studies are needed to assess driving parameters per each separate hip arthroscopic procedure, alternative clinical tests for the evaluation of driving performance, the postoperative incidence and severity of motor vehicle accidents, and the effect of other factors such as laterality, weightbearing restrictions, and manual versus automatic transmission.

REFERENCES

1. American Driving Survey. 2014-2017. AAA Foundation. Published February 27, 2019. Accessed September 5, 2021. https://aafoundation.org/american-driving-survey-2014-2017/
2. Bäcker HC, Krüger D, Spies S, Perka C, Kirschbaum SM, Hardt S. Effect of total hip arthroplasty on brake reaction time and braking force. Hip Int. 2022;32(1):51-55. doi:10.1177/1120700020936635
3. Balazs GC, Donohue MA, Brelin AM, Brooks DI, McCabe MP, Anderson TD. Reaction time and brake pedal depression following arthroscopic hip surgery: a prospective case-control study. Arthroscopy. 2018;34(5):1463-1470.e1. doi:10.1016/j.arthro.2018.02.030
4. Bolla I, Briggs KK, Philippou MJ. Superior clinical outcomes with capsular closure versus non-closure in patients undergoing arthroscopic hip labral repair. Orthop J Sports Med. 2018;6(3(suppl)):2325967118800009. doi:10.1177/2325967118800009
5. Bruera E, Macmillan K, Hanson J, MacDonald RN. The cognitive effects of the administration of narcotic analgesics in patients with cancer pain. Pain. 1989;39(1):13-16. doi:10.1016/0304-3959(89)80169-3
6. Burman MS. Arthroscopy or the direct visualization of joints: an experimental cadaver study. 1931. Clin Orthop Relat Res. 2001;390:5-9. doi:10.1007/0-0030886-20010000-00003
7. Byas-Smith MG, Chapman SL, Reed B, Cotsonis G. The effect of opioids on driving and psychomotor performance in patients with chronic pain. Clin J Pain. 2005;21(4):345-352. doi:10.1097/01.ajp.0000125244.29379.c1
8. Cochrane Handbook for Systematic Reviews of Interventions. Cochrane Training. Accessed September 9, 2021. https://training.cochrane.org/handbook
9. Cochrane Handbook for Systematic Reviews of Interventions. Cochrane Training. Accessed September 8, 2021. https://training.cochrane.org/handbook/current
10. Dammener D, Giesinger JM, Biedermann R, Haid C, Liebensteiner MC. The effect of knee brace type on braking response time during automobile driving. Arthroscopy. 2015;31(3):404-409. doi:10.1016/j.arthro.2014.08.003
11. Dammener D, Waidmann C, Haid C, Thaler M, Krismer M, Liebensteiner MC. The effect of ankle brace type on braking response time—a randomised study. Injury. 2015;46(11):2278-2282. doi:10.1016/j.injury.2015.07.038
12. Dammener D, Waidmann C, Huber DG, Krismer M, Haid C, Liebensteiner MC. Effect of hip braces on brake response time: repeated measures designed study. Prosthet Orthot Int. 2017;41(4):373-378. doi:10.1177/0309364616640925
13. Davis JA, Bohl DD, Gerlinger TL. Brake response time after modern total knee arthroplasty: how soon can patients drive? Knee. 2018;25(5):939-945.
14. Dickerson AE, Reistetter T, Parnell M, Robinson S, Stone K, Whitley K. Standardizing the RT-2 S brake reaction time tester. Phys Occup Ther Geriatr. 2008;27(2):96-106. doi:10.1080/20731808080236932
15. Dickerson AE, Reistetter TA, Burhans S, Apple K. Typical brake reaction times across the life span. Occup Ther Health Care. 2016;30(2):115-123. doi:10.3109/07380577.2015.1059971
16. DiSilvestro KJ, Santoro AJ, Tjoumakaris FP, Levicoff EA, Freedman KB. When can I drive after orthopaedic surgery? A systematic review. Clin Orthop Relat Res. 2016;474(12):2557-2570. doi:10.1007/s11999-016-5007-9
17. Domb GB, Charhabarkhasti EO, Perets I, Walsh JP, Yuen LC, Ashberg LJ. Patient-reported outcomes of capsular repair versus capsulotomy in patients undergoing hip arthroscopy: minimum 5-year follow-up—a matched comparison study. Arthroscopy. 2018;34(3):853-863.e1. doi:10.1016/j.arthro.2017.10.019
18. Dubois S, Bédard M, Weaver B. The association between opioid analgesics and unsafe driving actions preceding fatal crashes. Accid Anal Prev. 2010;42(1):30-37. doi:10.1016/j.aap.2009.06.030
19. Frane N, Bandovic I, Hu V, Bitterman A. Return-to-driving recommendations after lower-extremity orthopaedic procedures. JBJS Rev. 2020;8(12):e20.00066. doi:10.2106/JBJS.RVW.20.00066
20. Gaški T, Williams JB, Ehle HT. Effects of opioids on driving ability. J Pain Symptom Manage. 2000;19(3):200-208. doi:10.1016/s0885-9244(99)00158-x
21. Giddins GE, Hammerton A. "Doctor, when can I drive?" A medical and legal view of the implications of advice on driving after injury or operation. Injury. 1996;27(7):495-497. doi:10.1016/0020-1383(96)00054-x
22. Green M. “How long does it take to stop?” Methodological analysis of driver perception–brake times. Transp Hum Factors. 2000;2(3):195-216. doi:10.1207/S10737492THF0203_1
23. Hartman J, Thornley P, Oreskovich S, Adili A, Bedi A, Khan M. Braking time following total knee arthroplasty: a systematic review. *J Arthroplasty*. 2018;33(1):284-290.e1. doi:10.1016/j.arth.2017.08.012

24. Jo S, Lee SH, Jang SW, et al. Time taken to resume driving following hip arthroscopy. *BMC Musculoskelet Disord*. 2020;21(1):10.1186/s12891-020-03662-y.

25. Johansson G, Rumar K. Drivers’ brake reaction times. *Hum Factors*. 1971;13(1):23-27. doi:10.1177/001872087101300104

26. Khanduja V, Villar RN. Arthroscopic surgery of the hip: current concepts and recent advances. *J Bone Joint Surg Br*. 2006;88(12):1557-1566. doi:10.1302/0301-620X.88B12.18584

27. Kwapisz A, Momaya A, Stavrinos D, et al. Return to driving after hip arthroscopy. *Arthroscopy*. 2017;33(10):e148.

28. Liebermann DG, Ben-David G, Schweitzer N, Apter Y, Parush A. A field study on braking responses during driving, I: triggering and modulation. *Ergonomics*. 1995;38(9):1894-1902. doi:10.1080/00140139508925237

29. MacKenzie JS, Bitzer AM, Familiari F, Papalia R, McFarland EG. Driving after upper or lower extremity orthopaedic surgery. *Joints*. 2018;6(4):232-240.

30. MacLeod K, Lingham A, Chatha H, et al. “When can I return to driving?” A review of the current literature on returning to driving after lower limb injury or arthroplasty. *Bone Joint J*. 2013;95(3):290-294.

31. Maradit Kremers H, Schilz SR, Van Houten HK, et al. Trends in utilization and outcomes of hip arthroscopy in the United States between 2005 and 2013. *J Arthroplasty*. 2017;32(3):750-755. doi:10.1016/j.arth.2016.09.004

32. Meyr AJ, Sansosti LE. A review of the effect of lower-extremity pathology on automobile driving function. *J Am Podiatr Med Assoc*. 2019;109(2):132-140. doi:10.7547/16-089

33. Moher D, Liberati A, Tetzlaff J, Altman DG; the PRISMA Group. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: the PRISMA statement. *BMJ*. 2009;339:b2535. doi:10.1136/bmj.b2535

34. Momaya AM, Stavrinos D, McManus B, Wittig SM, Emblov B, Estes R. Return to driving after hip arthroscopy. *Clin J Sport Med*. 2018;28(3):299-303. doi:10.1097/JSM.0000000000000457

35. OCEBM Levels of Evidence. Centre for Evidence-Based Medicine (CEBM), University of Oxford. Accessed September 6, 2021. https://www.cebm.ox.ac.uk/resources/levels-of-evidence/occebmlsizes-of-evidence

36. Olson PL, Sivak M. Perception-response time to unexpected roadway hazards. *Hum Factors*. 1986;28(1):91-96. doi:10.1177/00187208860280110

37. Patel PV, Giannoudis VP, Palma S, et al. Doctor when can I drive? A systematic review and meta-analysis of return to driving after total hip arthroplasty. *HIP Int*. Published online March 18, 2021. doi:10.1177/11207002021998028

38. Perez-Mozas M, Mayo-Ollero J, Montiel V, Valenti-Nin JR, Valentí-Aznarate A. Meniscal suture influence on driving ability 6 weeks after anterior cruciate ligament reconstruction with hamstring autograft. *J Knee Surg*. 2021;39(9):23259671211033584. doi:10.1055/s-0041-1729553

39. Rath E, Sharfman ZT, Paret M, Amar E, Drexlter M, Bonin N. Hip arthroscopy protocol: expert opinions on post-operative weight bearing and return to sports guidelines. *J Hip Preserv Surg*. 2017;4(1):60-66. doi:10.1093/jbps/ijnv045

40. Rossi MJ, Brand JC, Lubowitz JH. Return to driving after arthroscopic and related surgery: before patients start, how do we know they can stop? *Arthroscopy*. 2018;34(6):1745-1747. doi:10.1016/j.arthro.2018.04.007

41. Rounds A, Rosario SL, Navo P, et al. Return to driving after hip arthroscopy. *J Investig Med*. 2018;66(1):276-277. doi:10.1136/jim-2017-000663.511

42. Salem HS, Park DH, Friedman JL, et al. Return to driving after anterior cruciate ligament reconstruction: a systematic review. *Orthop J Sports Med*. 2021;9(1):2325967120968556. doi:10.1177/2325967120968556

43. Slim K, Nini E, Forestier D, Kwiatkowski F, Panis Y, Chipponi J. Methodological index for non-randomized studies (MINORS): development and validation of a new instrument. *ANZ J Surg*. 2003;73(9):712-716. doi:10.1016/S0003-2403(03)00397-5

44. Stevens MS, LeGay DA, Glazebrook MA, Amiraud D. The evidence for hip arthroscopy: grading the current indications. *Arthroscopy*. 2010;26(10):1370-1383. doi:10.1016/j.arthro.2010.07.016

45. Vera AM, Beauchman N, McCulloch PC, Gerrie BJ, Delgado DA, Harris JD. Brake reaction time after hip arthroscopy for femoroacetabular impingement and labral tear. *Arthroscopy*. 2017;33(5):971-976. doi:10.1016/j.arthro.2016.11.020

46. Yoshida B, Bolia IK, Collon K, et al. Driving performance and turning reaction time following hip arthroscopy for FAIS: does capsular repair matter? *HIP Int*. Published online April 8, 2021. doi:10.1177/112070020211006778