Research Article
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Endoscopic gluteus medius partial tear repair with collagen patch augmentation. Clinical and imaging results

Abstract

Introduction: Gluteus medius (GM) partial and total tears are often the cause of lateral hip pain. Non-surgical management is the first approach, however, open and endoscopic repair techniques have been described in refractory cases. The use of collagen patches has been proposed as an augmentation to enhance healing. This study aims to describe our technique for repairing partial tears of the GM tendon and present clinical and imaging results.

Materials and methods: Prospective cohort on 15 hips with lateral hip pain and a positive Trendelenburg test, who had a partial thickness tear of the GM tendon on MRI. The patients had not responded to non-surgical treatment for at least 6 months and underwent endoscopic repair with a collagen patch augmentation between 2019 and 2022. The postoperative Modified Harris Hip Score (mHHS), International Hip Outcomes Tool-12 (iHOT-12), Visual Analogue Score (VAS), patient satisfaction, Trendelembug test, and control MRI to assess healing at 3 months were obtained.

Results: 100% female, mean age of 56.66 years. Mean follow-up was 11 (4-24) months. Median mHHS improved significantly from 68 to 82 points (p=0.001). The median iHOT-12 improved significantly from 70 to 83 points (p=0.001). Median VAS decreased significantly from 6 to 2 (p<0.001). All patients had a negative Trendelenburg test at the end of the follow-up, and all reported being satisfied. There were no complications and all cases showed healing.

Conclusion: Our endoscopic technique has shown positive clinical outcomes for patients with partial ruptures, resulting in complete healing without short-term complications.

Keywords: trendelenburg test, hip pain, physiotherapy, anti-inflammatory drugs

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Abbreviations: GM, gluteus medius; mHHS, modified harris hip score; VAS, visual analogue score; ISHA, international society of hip arthroscopy; PPLA, proximal posterolateral accessory; DPLA, distal posterolateral accessory; MPLA; medium posterolateral accessory; IQR, interquartile range; PROMs, patient-reported outcome measures

Introduction

Peritrochanteric pain refers to a type of pain experienced on the lateral side of the hip. It affects up to 25% of the population, with middle-aged women being more commonly affected.[1,2] This condition encompasses bursitis, tendinopathy, as well as partial or complete tears of the hip abductor muscles tendons.[3,4] Previously, lateral hip pain was treated non-surgically with anti-inflammatory drugs, physiotherapy, and local infiltrations due to limited surgical options, lack of diagnostic precision, and poor functional-anatomical knowledge.[4–8] Lateral hip pain is often caused by tears in the tendons of the abductor muscles. These tears are most commonly degenerative and partial thickness lesions of the gluteus medius (GM) tendon.[9–12]

Tears of the GM and minimus tendons are referred to as "the hip rotator cuff" by multiple authors,[13,14] which may occur through a degenerative process, as occurs with rotator cuff tears in the shoulder.[2,10,15,16] Orthopedic surgeons have gained interest in the anatomical precision of the hip abductor apparatus and the morphology of these tears.

The insertional anatomy of the GM and the characteristics of the tendon tears have recently been described,[2] specifying the diagnosis. In cases where a lesion has been identified and conservative treatment has not produced satisfactory results, surgical interventions such as open and endoscopic techniques have been described. Both techniques have reported good clinical outcomes with comparable results in terms of functionality and pain.[17,18] However, complications related to open techniques have been reported.[19]

Although these techniques have shown promising clinical results, 5-25% of the repairs fail to heal.[20,21] This could result in worse clinical outcomes. To enhance the healing process of tendon repairs, bioinductive collagen patches have been utilized, firstly applied in repairing the rotator cuff in the shoulder.[22,23] This bioinductive collagen patch has been used in open repairs of the hip abductor apparatus,[17] describing its safety and favorable clinical results.

This study aims to describe our endoscopic technique for repairing partial tears in the GM tendon by employing a bioinductive collagen patch for augmentation. Our secondary goal is to demonstrate the clinical and imaging outcomes.

Material and methods

Between 2019 and 2022, a prospective cohort study was conducted to assess patients with lateral hip pain. Patients with evidence of partial tear at the level of the GM tendon, and who had at least 6 months of refractory conservative management were included. The study excluded patients under 18 years of age, those with a history of previous hip arthroscopy, endoscopy, arthroplasty, fracture, or failed repair of a previous ipsilateral hip abductor tendon. The endoscopic procedure was performed by the same surgeon (DP). In all cases,

we obtained a thorough medical history, physical examination, and functional assessment using the Modified Harris Hip Score (mHHS), the International Hip Outcomes Tool - 12 (iHOT-12), and the Visual Analog Pain Scale (VAS). We conducted a post-operative MRI of the operated hip side after 3 months to evaluate healing, which was analyzed by radiologists from our institution who specialize in musculoskeletal imaging. All patients were informed of the procedure and signed their consent.

The data was analyzed using the SPSS® (version 23.0, from IBM Co. in Armonk, USA). The Kolmogorov-Smirnov test was used to determine normality. All variables had a non-parametric distribution. For paired samples, the Wilcoxon rank test was used to analyze group differences. The significance level was set at $P < 0.05$.

Surgical technique

The procedure is carried out on an outpatient basis, using spinal anesthesia in all patients. The patient is placed in a supine position, and sterile fields are then applied to cover the trochanteric area using Ioban® (Two Harbors, Minnesota, United States). During the surgical procedure, the limb is positioned free for control and manipulation. To gain access to the lateral and posterior space, two endoscopic portals are made using a technique described by one of the co-authors of this article during the 2022 annual scientific meeting of the International Society of Hip Arthroscopy (ISHA).[24] This technique has been developed for the management of deep gluteal pain syndrome, as described in our previous publication.[25] The distance between the anterior and posterior border of the greater trochanter at the level of the vastus tuberosity is demarcated, projecting this distance equidistantly in the posterior third of the femur towards proximally and distally, delimiting the proximal posterolateral accessory (PPLA) and distal posterolateral accessory (DPLA) portals Figure 1.

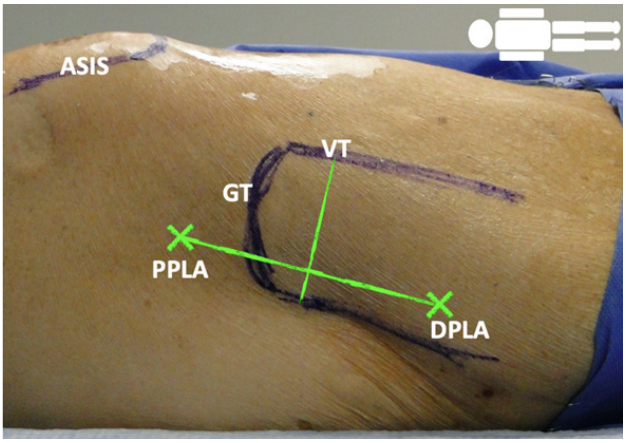

Figure 1 Demarcation of the portals.[24,25] The anterosuperior iliac spine (ASIS), greater trochanter (GT), vastus tuberosity (VT), the proximal posterolateral accessory (PPLA) and distal posterolateral accessory (DPLA) portals are identified.

To perform a DPLA portal, a small incision is made in the skin, followed by an opening in the iliotibial band. To avoid the risk of hypothermia, a warmed physiological solution is used during the procedure.[26–28] Using endoscopic assistance with 70º optics, a second portal, the PPLA, is made, with a constant flow at a rate of 0.7 liters/minute and a pressure of 40mmHg per bomb. The procedure starts with the hip at a 30º abduction and 0º internal rotation. Then, a partial tenotomy of the distal insertion of the gluteus maximus is performed. The tenotomy is done at the proximal level on the linea aspera, in an anterior-to-posterior direction Figure 2. The tenotomy procedure increases the virtual space available, allowing complete access and reducing pressure on the lateral space. After identifying the greater trochanter, a bursectomy is performed to locate the GM tendon. The tendon shows partial fatty infiltration and tendinopathic appearance on its lateral surface but without tears Figure 3.

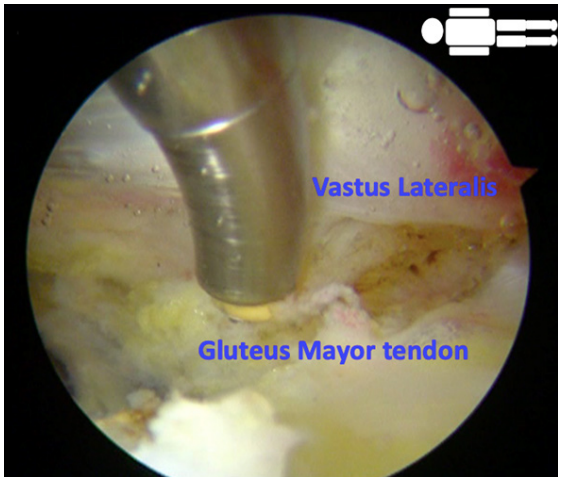

Figure 2 Partial tenotomy of the distal insertion of the gluteus maximus tendon.

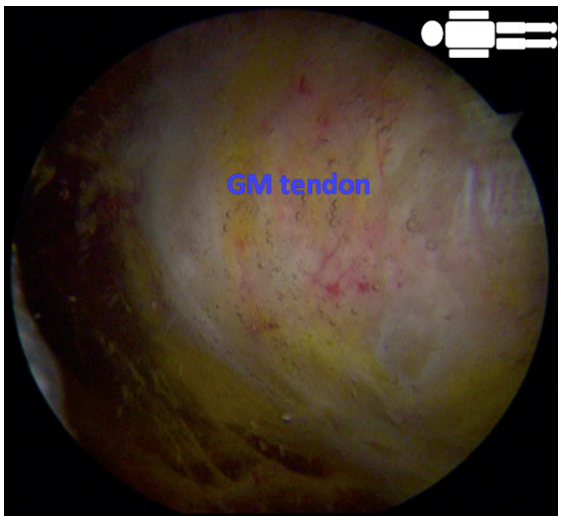

Figure 3 GM tendon, tendinopathic in appearance, but without rupture on its lateral surface.

Tears are always found on the medial side, which cannot be directly observed. It is explored by palpation to rule out a complete rupture. A third portal is made at the midpoint equidistant between the PPLA and DPLA, the medium posterolateral accessory (MPLA) portal Figure 4. Through this MPLA portal, nine perforations are made in the greater trochanter at the level of the GM insertion with a 2.3mm Bioraptor® anchor drill bit (Smith & Nephew, London, United Kingdom) at a depth of 2.5cm, distributed symmetrically separated approximately 1cm from each other Figure 5. Through the DPLA portal, an 8.25mm cannula specific to the implant is inserted, and then the Regeneten® bioinductive patch loaded is passed. Once the implant has been placed in the desired position, 6 anchors of the Regeneten® system for soft tissues (4.5x6.5mm) are placed through the MPLA portal to set the patch Figure 6. Subsequently, the stability of the implant is confirmed by hip rotation and flexion-extension movements Figure 7. Instruments are removed and the skin is sutured, concluding the surgical procedure.

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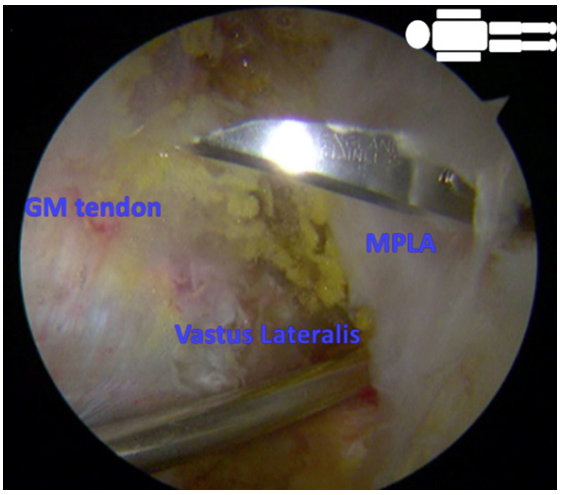


Figure 4 Realization of the medium posterolateral accessory (MPLA) portal, equidistant to the PPLA and DPLA portals.

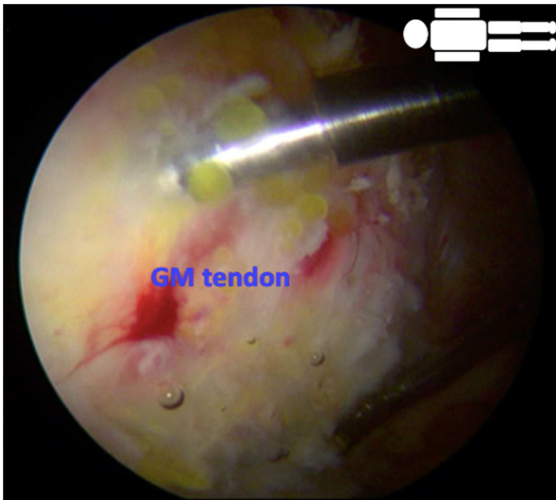


Figure 5 nine perforations are made in the greater trochanter at the level of the GM insertion with a 2.3mm Bioraptor® anchor drill bit (Smith & Nephew, London, United Kingdom) at a depth of 2.5cm through the MPLA portal, observing with the optics from the PPLA portal.

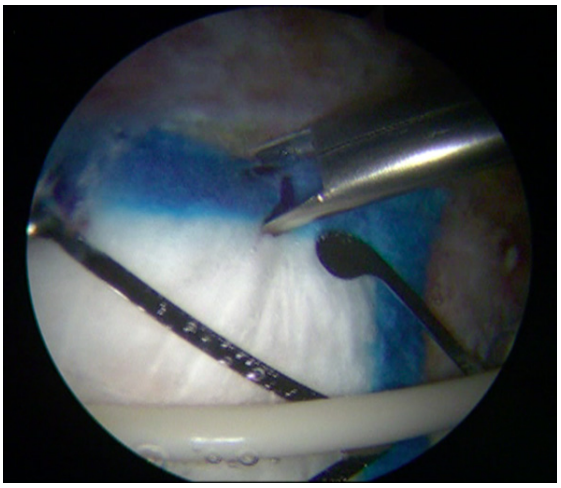


Figure 6 The implant is inserted through the DPLA portal and fixed with six anchors (4.5x6.5mm) through the MPLA portal when viewed from the PPLA portal.

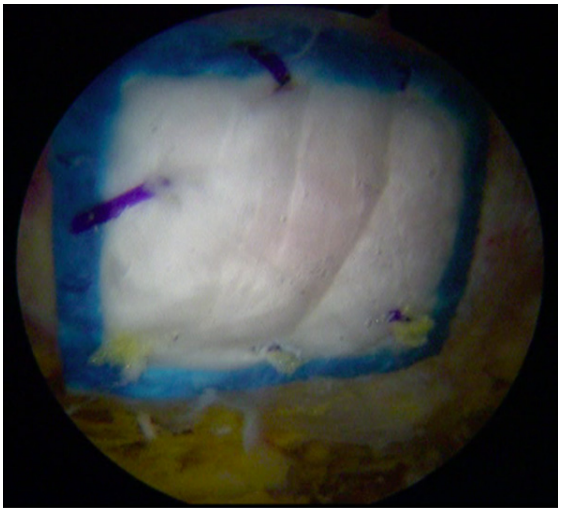


Figure 7 Hip rotations are performed to assess implant stability.

Rehabilitation and follow-up protocol

The patient used fully loaded support and was protected with two crutches from the first day for twelve weeks. Isometric hip exercises were started after twelve weeks, followed by progressive strengthening. Specific sports activities began in the fourth month. A control MRI of the operated hip was performed to check the healing of the GM tendon Figure 8.

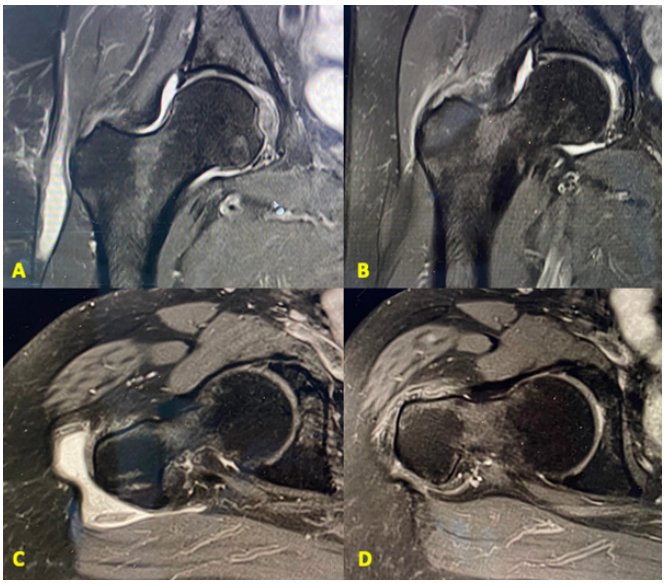


Figure 8 Preoperative MRI in coronal (A) and axial (C) slices with evidence of partial rupture of the GM tendon on its medial side. Follow-up MRI at three months in coronal (B) and axial (D) slices showing continuous scar tissue of the GM tendon.

Results

A total of twelve patients (15 hips), who met the required criteria were chosen for GM repair. All of them were women with an average age of 56.66 years (42-70). The mean follow-up period was 11 months (4-24). The demographic data is illustrated in Table 1. The median mHHS improved from 68 points (interquartile range [IQR], 59, 68 points) preoperatively to 82 points (IQR, 76, 88 points) at the latest follow-up (p=0.001) Table 2, Graphic 1. According to the mHHS

score, 7% obtained excellent results (>90), 67% had good results (80-89), 26% fair results (70-79), and 0% had poor results (<70) Graphic 2. The median iHOT-12 score also improved from 70 points (IQR, 60, 80 points) preoperatively to 83 points (IQR, 82, 88 points) at the latest follow-up (p=0.001) Table 2, Graphic 3. There was a significant improvement (p<0.001) in the median VAS score in the total sample from 6 (IQR, 6, 7) preoperatively to 2 (IQR, 2, 5) postoperatively Table 2, Graphic 4. At the latest follow-up, 8 (66%) patients reported being very satisfied, 4 (33%) satisfied. During follow-up, there were no complications related to the surgical procedure. In the 3-month MRI study, all patients showed healing of the partial lesion of the GM tendon. Additionally, all patients presented a negative Trendelenburg test at the end of postoperative follow-up.

Table 1 Sample demographics data

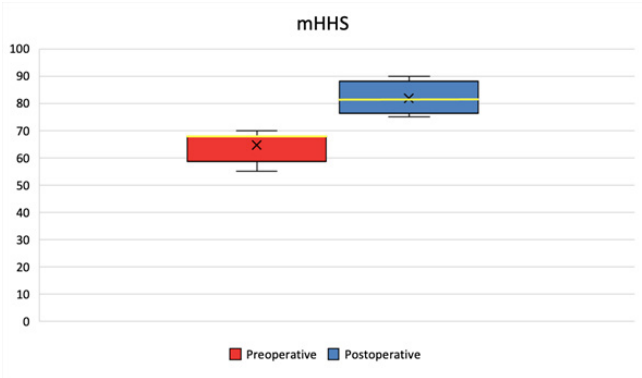
Patients	12
Hip	15
Female (%)	15 (100%)
Body mass index (KG/m2)	28.2 (24.6-35.3)
Age* (years)	56.66 (42-70)
Follow-up* (months)	11 (4-24)

*The values are given as the mean, with the range in parentheses.

Table 2 Functional tests and pre and postoperative VAS

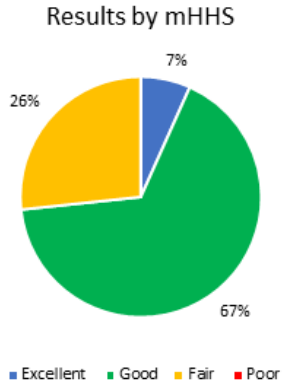
Total	Preoperative score*	Postoperative score*	p value
mHHS	68 (IQR 59, 68)	82 (IQR 76, 88)	p=0.001†
iHOT-12	70 (IQR 60, 80)	83 (IQR 82, 88)	p=0.001†
VAS	6 (IQR 6, 7)	2 (IQR 2, 5)	p<0.001†

*The values are given as the median, with the IQR in parentheses. †Significant



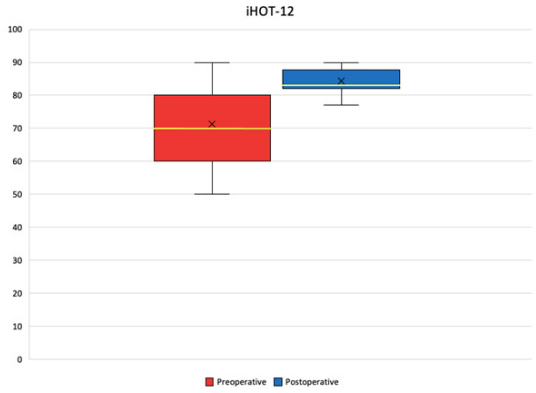
Graphic 1 mHHS preoperative and postoperative outcomes.

The median mHHS was 68 points (IQR, 59, 68 points) preoperatively and 82 points (IQR, 76, 88 points) postoperatively. The x indicates the mean, the yellow line indicates the median, the box indicates the IQR, and the whiskers indicate the range.



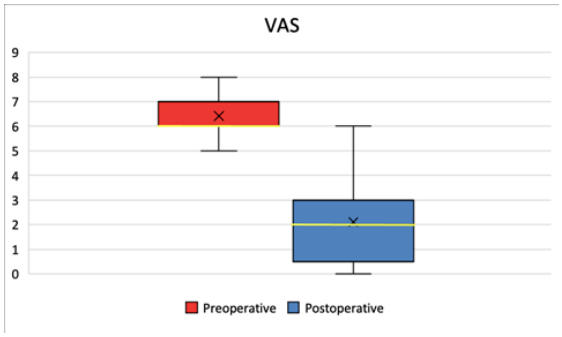
Graphic 2 Classification of the results by mHHS.

Excellent = >90 points; Good = 80-89 points; Fair= 70-79 points; Poor = <70 points.



Graphic 3 iHOT-12 preoperative and postoperative outcomes.

The median iHOT-12 was 70 points (IQR, 60, 80 points) preoperatively and 83 points (IQR, 82, 88 points) postoperatively. The x indicates the mean, the yellow line indicates the median, the box indicates the IQR, and the whiskers indicate the range.



Graphic 4 VAS preoperative and postoperative outcomes.

The median VAS score was 6 (IQR, 6, 7) preoperatively and 2 (IQR, 2, 5) postoperatively. The x indicates the mean, the yellow line indicates the median, the box indicates the IQR, and the whiskers indicate the range.

Discussion

This study aimed to assess the effectiveness of endoscopic repair with bioinductive collagen patch augmentation for partial GM tendon tears, and multiple perforations at the level of the greater trochanter without completing the injury, using modified portals developed by the authors. We included 15 hips in the cohort and observed a statistically significant improvement in patient-reported outcome measures (PROMs) and postoperative pain without any complications related to the surgical procedure. Healing of the GM was achieved in all cases, as observed by MRI.

Tears in the hip abductor tendon apparatus have been increasingly recognized as an important cause of lateral hip pain, particularly middle-aged women.[21,29] Tears in the GM tendon are the most common cause of chronic pain with functional limitation. Patients with partial tears that have failed non-surgical treatment and complete tears are candidates for surgical intervention. The benefits of repair have been demonstrated in different studies, using both open and endoscopic techniques.[29,30] Both approaches are comparable for repairing GM tendon tears, with good to excellent functional results; however, endoscopic repair has the benefits of being a less invasive approach, being able to be performed as an outpatient procedure, in addition, to have a lower rate of recurrence of tendon rupture.

In 2007, Voos et al. described the first endoscopic repair for the GM tendon.[31] In 2009, they presented a group of 10 patients with 50% partial tears of the GM tendon. In this group, the injury was completed before repair and then sutured with 1 anchor in the footprint. At a 2-year follow-up, all patients had complete resolution of their pain and recovered abductor strength. There were no clinical repair failures or perioperative complications, and the average postoperative mHHS score was 94 points. Only 3 patients underwent a control MRI 6 months after surgery, and all these cases showed healing. Regarding complete tears of the GM tendon, McCormick et al. published the first cohort of 10 patients, excluding partial lesions, in whom endoscopic repair was performed with a transosseous-equivalent technique. At the end of the follow-up, the authors only reported the mean postoperative scores which were 84.7 points for the mHHS, with 90% of patients being satisfied and all with an improvement in abductor strength. These clinical results are favorable in complete lesions. They did not perform a postoperative MRI in the follow-up of their study.[29]

In a study conducted by Chandrasekaran et al.[32] on a group of 34 patients, the longest study to date, 24 cases of partial tears were identified. In 17 of these cases, the instability of the medial surface of the GM muscle was first confirmed by palpation over the lateral facet. A transtendinous window was then created by making a longitudinal incision in the tendon, along its fibers. The torn fibers on the medial surface were identified and removed, followed by a side-to-side repair.[32] Although there were some improvements in gait deviation and abductor strength, they were not significant. However, there was a significant improvement in pain and PROMs at 2-year follow-up, with no significant differences between the techniques used for partial and total tears. No new tears were found, which is consistent with our results and the literature, indicating that this endoscopic management approach is safe. Chandrasekaran et al.[32] did not perform a routine MRI to assess the healing of the repair. Additionally, all patients underwent surgical correction of previous intraarticular pathologies, which may limit the interpretation of the outcomes.[32–36]

We did not include patients with concomitant intraarticular or sciatic nerve pathology to avoid bias. In a recent study.[37] published a series of 20 hips, with 12 partial lesions treated endoscopically. In partial injuries, a longitudinal incision was made in the GM tendon, debriding the degenerative fibers, decorticating the lateral facet bone to create bleeding bone, and performing a knotless anchor repair using non-absorbable sutures for all GM repairs. There were statistically significant improvements in the postoperative PROMs scores for patients with partial and total tears, with no differences between the cohorts at 2 years of follow-up. Notably, the MRI from this study revealed that 85% of the GM had a Goutallier 0 or 1. This variable was not measured in our study, which has been identified as a factor for increased pain, decreased satisfaction, and poorer functional results after repair.[38]

Domb et al.,[39] have developed an endoscopic technique for treating partial tears of the gluteus tendon. Their technique involves using various portals, including anterolateral, midanterior, distal accessory, and posterolateral portals. For partial tears, they perform a side-to-side repair.[39] In 2013, they presented a group of 15 patients who underwent endoscopic treatment. Among these, 6 cases were partial tears, which were repaired using a transtendinous side-to-side suture. All patients reported improved outcomes after the surgery, with excellent satisfaction and better results on the resisted muscular contraction scale. However, 2 patients continued to experience lateral pain, and one patient required a total hip arthroplasty. It is worth noting that all patients also underwent labral debridement and other intra-articular procedures.[32]

In some cases, Domb et al.,[40] perform the repair by creating an iliotibial band window or by inserting the arthroscope directly into the peritrochanteric compartment from the midanterior portal. However, creating an iliotibial band window may negatively affect the abductor function of the gluteus maximus and tensor fascia lata.[41] Therefore, we suggest that it is preferable to perform a partial tenotomy of the gluteus maximus distal insertion, decompressing the lateral space, and maintaining the biomechanical continuity of the gluteus maximus-tensor fascia lata. We believe that the lateral inflammatory pathology is caused by a frictional problem between the iliotibial band and the greater trochanter.

Day et al.,[17] reported using the Regeneten® patch in nine partial lesions of the GM tendon through an open approach. They identified the lesion on the medial side of the GM tendon, made a longitudinal incision over the defect, debrided the area, and made a repair with double row sutures. They then placed the patch over the repair. Significant improvement in the PROMs at 6 months were obtained. However, they reported healing on the MRI in only 77.8%. Despite this outcome, Day et al. reported a significant increase in the cross-sectional area of the GM muscle. We have observed that all cases have shown healing at the 3-month. We attribute this to the use of a collagen patch and the fact that we did not complete the lesion during the procedure. Additionally, we made multiple perforations at the greater trochanter, which sets our study apart from previous ones. We believe that healing and the Trendelenburg test are important factors as they can be objectively measured, unlike pain and PROMs, which are subjective and can be influenced by multiple factors.

Regarding the limitations of this study, the sample size is small, which limits the conclusions of the improvement of the clinical results of this intervention. The follow-up period makes it not possible to evaluate longer-term results and complications. This study is not comparative, therefore there is no control group using another technique described for the repair of partial GM lesions. We did not objectivize with a scale the muscular abductor function and we did not perform the Goutallier measurement on MRI for the GM muscle 3 months after surgery.

This study presents some significant strengths. Firstly, we introduce new modified portals that provide complete access to the lateral and posterior spaces. Additionally, we describe an endoscopic repair method that does not involve completing the partial lesion but instead uses perforations to the trochanter, and the application of a collagen patch to enhance the healing process. Finally, we assess healing using MRI in all patients.

Conclusion

Our endoscopic repair of the GM through modified portals, using a bioinductive collagen patch, perforations to the greater trochanter not completing the lesion, and additionally, a partial tenotomy of the distal insertion of the gluteus maximus achieves good clinical results in patients with partial tears. All tendons healed, and no short-term complications were observed.

Acknowledgments

None.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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