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Medical Coverage Policy

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High Intensity Focused Ultrasound (HIFU)

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Overview

This Coverage Policy addresses high-intensity focused ultrasound (HIFU)/magnetic resonance (MR)-guided, focused ultrasound (MRgFUS) for various conditions, such as fibroids, and prostate, bone, and renal cancers.

Coverage Policy

High-intensity focused ultrasound (HIFU) is considered medically necessary as a treatment for recurrent localized prostate cancer following the failure of radiation therapy when BOTH of the following criteria are met:

- positive, recent (i.e., repeat), transrectal ultrasound guided (TRUS) biopsy completed due to suspicion of local recurrence of prostate cancer
- candidate for local therapy alone as evidenced by the absence of distant metastases

Magnetic resonance (MR)-guided focused ultrasound (MRgFUS) is considered medically necessary for pain palliation in an individual with metastatic bone cancer who has failed or is not a candidate for radiotherapy.

Magnetic resonance (MR)-guided focused ultrasound (MRgFUS) unilateral thalamotomy using a U.S. Food and Drug Administration (FDA) approved device is considered medically necessary for the treatment of essential tremor (ET) when ALL of the following criteria are met:

- tremor is refractory to at least two trials of medical therapy, including at least one first-line agent (e.g., propranolol or primidone)
- tremor is moderate to severe (defined by a score of ≥ 2 on the clinical rating scale for tremor [CRST])
- the treatment plan to use MRgFUS unilateral thalamotomy has been agreed upon by a multidisciplinary team of physicians to include at least two specialists (e.g., neurosurgery, neurology) and, after considering all relevant possible treatment approaches, MRgFUS unilateral thalamotomy is determined to be the best treatment option

High-intensity focused ultrasound (HIFU), including magnetic resonance (MR)-guided focused ultrasound (MRgFUS) is not medically necessary for ANY other indication including as an initial treatment for localized prostate cancer.

Magnetic resonance (MR)-guided transurethral ultrasound ablation (TULSA) is considered experimental, investigational or unproven for the treatment of prostate cancer.

General Background

High Intensity focused Ultrasound (HIFU)

High intensity focused ultrasound (HIFU) is a minimally invasive surgical technique for the thermal ablation of both malignant and benign tumors and cessation of internal bleeding in injured vessels and organs with little damage to the surrounding tissue. HIFU has been proposed as an alternative to surgery for treatment of cancer and other tumor types, including but not limited to prostate, breast, brain, and renal cancer. It is also being used for palliation of pain (e.g., tumors metastasis to bone).

Prostate Cancer
HIFU has been proposed as treatment for localized prostate cancer and as salvage therapy for recurrent prostate cancer. Methods to manage localized prostate cancer include watchful waiting and active surveillance. Treatment options for localized prostate cancer include radical prostatectomy, radiotherapy, brachytherapy, cryotherapy, and intensity-modulated radiation therapy (IMRT). Treatment of recurrent cancer depends on factors such as the primary treatment method, extent of the cancer, and site of recurrence and includes options similar to those for localized prostate cancer. Transrectal HIFU involves the use of a probe to image the prostate and deliver timed bursts of heat to create coagulation necrosis in a targeted area. HIFU remains unique compared with other modalities for localized prostate cancer in that it has been proposed to result in much less adjacent tissue damage. This makes it a repeatable technology and thus potentially more salvageable by other techniques when it fails. A cooling balloon surrounding the probe protects the rectal mucosa from the high temperature. HIFU treatment can be repeated if necessary. This procedure is typically carried out in an outpatient setting and is performed under spinal or general anesthesia. Prolonged urinary retention secondary to edema and urethral sloughing have been the most common reported complications following primary HIFU treatment. Therefore, many of the current HIFU techniques include a pre-procedural TURP. Reported long-term complications following salvage HIFU include rectourethral fistulas, incontinence, rectal or perineal pain, erectile dysfunction and bladder neck contractures or urethral strictures (Ahmed and Emberton, 2016; Koch, 2011; Chaussy, et al., 2011; Rebillard, et al., 2008; Zelefsy, et al., 2008).

U.S. Food and Drug Administration (FDA): On June 7, 2018 the Focal One® (EDAP Technomed, Inc, Austin, TX) was determined to be substantially equivalent to the Ablatherm and Sonablate and is indicated for the ablation of prostate tissue (FDA, 2018). "The Focal One® is an evolution from the previous generation device, designed by EDAP: Ablatherm Integrated Imaging (K153023) and Ablatherm Fusion (K172285). The Focal One consists of the Focal One module with a software control system, an endorectal dynamic focusing probe, a leg holder, a set of single use disposables and a coupling liquid pouch" (FDA, 2018).

On July 28, 2017, the Ablatherm® Fusion was determined to be substantially equivalent to Ablatherm® Integrated Imaging and Sonablate® and is indicated for the ablation of prostate tissue. The purpose of the 510(k) submission was to add an optional feature that would provide MRI images and/or biopsies positions fused with the system's live ultrasound imaging. This option is referred to as AblaFusion (FDA, 2017). On November 6, 2015, the FDA granted 510(k) marketing clearance for the Ablatherm Integrated Imaging High-Intensity Focused Ultrasound (HIFU) device (EDAP Technomed, Inc., Austin, TX). The Ablatherm was determined to be substantially equivalent to the Sonablate device and is indicated for the ablation of prostate tissue. Ablatherm HIFU is administered via a transrectal probe under imaging guidance. The device uses HIFU to elevate the tissue temperature within the target zone of the prostate, resulting in tissue necrosis, while the surrounding tissue is kept at physiologically safe temperatures. Ablatherm HIFU treatment completely destroys the targeted prostate tissue (FDA, 2015).

On October 9, 2015, the Sonablate® 450 (SonaCare Medical, Inc., Charlotte, NC), and substantially equivalent devices of this generic type, was granted a change in FDA classification from class III to class II under the generic name high intensity ultrasound system for prostate tissue ablation. On December 21, 2016, the FDA granted 510(k) marketing clearance for the Sonablate® device (FDA, 2016).

Literature Review - Recurrent Prostate Cancer Following Radiation Therapy: The peer-reviewed published literature consists of non-randomized controlled trials and case series (Ingrosso, et al., 2020; Khoo, et al., 2020; Jones, et al., 2018; Crouzet, et al., 2017; Ahmed, et al., 2012; Wu, et al., 2011; Asimakopoulos, et al., 2011; Boutier, et al., 2011; Chaussy, et al., 2011; Ganzer, et al., 2011; Koch, et al., 2011).

Maestroni et al. (2021) conducted a systematic review that evaluated the safety and cancer control rates of high-intensity focused ultrasound (HIFU) following failure of External Beam Radiation Therapy (EBRT) for localized prostate cancer. The analysis included predominantly retrospective studies (n=13) with a cohort of 1241 patients. All patients underwent EBRT prior to HIFU for localized prostate cancer. The mean age was 68.6 years, ranging from 53–83 years with a prostate specific antigen (PSA) value of 5.87 ng/mL before treatment. At the time of salvage HIFY, 38.3% patients were on androgen-deprivation therapy and 24.71% continued the therapy after the treatment. Follow-up ranged from 3–168 months with a mean follow-up of 24.3 months after salvage HIFU. The percentage of patients who had recurrence was 51.6% which was independent of the length of follow-up. The overall survival (OS) was 85.2% at five years and one study reported an OS of 72% at seven years. The authors concluded that salvage HIFU is effective in the treatment of radiorecurrent clinically localized prostate cancer.

Ingrosso et al. (2020) conducted a systematic review and meta-analysis that evaluated the role of nonsurgical salvage modalities in radiorecurrent prostate cancer and the associated clinical outcomes with toxicity profiles. The meta-analysis included 64 case-series studies with a cohort of 5585 patients. All patients underwent primary radiation therapy (RT) for localized prostate cancer. Clinical outcomes were measured using the Phoenix definition to determine biochemical control rates while toxicity was measured using the Common Terminology Criteria for Adverse Events (CTCAE) and Clavien-Dindo scales. Brachytherapy (BT) and cryotherapy (CRYO) were investigated in 22 studies, HIFU in 13 studies, and EBRT in seven studies. The median follow-up after salvage therapy was 31 months. Patients underwent different imaging modalities to assess local relapse including MRI and choline PET. Prostate biopsies were performed in 5546 patients, for which the median Gleason score was 7. Biochemical control rates were lowest for patients treated with HIFU and highest for patients treated with BT and EBRT. The lowest prevalence of incontinence was for patients treated with BT and the highest was among patients treated with HIFU. The authors concluded that nonsurgical therapeutic options, especially BT, showed good outcomes in terms of biochemical control and tolerability in the local recurrence setting.

Rebillard et al. (2008) conducted a systematic review of the literature. The authors reported that published clinical studies on HIFU are limited to case series; neither randomized studies comparing HIFU with another technique or active surveillance, nor studies with matched controls were found. Most papers originated in a few centers and it appears that several articles related to the same study with different numbers of patients and/or different times of follow-up. Most reports were of single-center studies. The authors reported that long-term follow-up studies are needed to further evaluate cancer-specific and overall survival rates. In addition, the efficacy and safety of HIFU as a primary therapy should be further evaluated in randomized controlled trials comparing it with other (minimally invasive) therapies. These are the same conclusions reported in a systematic review of the literature by Warmuth et al. (2010).

Although not robust, evidence in the form of prospective and retrospective non-comparative studies suggests that HIFU is safe and effective for a subset of individuals for localized recurrent prostate cancer after treatment with radiation therapy.

Literature Review - Primary Prostate Cancer Therapy: There is currently a paucity of evidence in the published peer-reviewed medical literature evaluating the safety and effectiveness of HIFU as primary therapy for localized prostate cancer. The evidence is primarily in the form of prospective, retrospective and systematic reviews (Bakavicius, et al., 2022; Marra, et al., 2022; Bates, et al., 2021; Abreu, et al., 2020). There is a lack of well-designed, long-term studies available that compare the clinical outcomes of HIFU to the standard of care (e.g., radical prostatectomy, radiotherapy, brachytherapy, intensity-modulated radiation therapy). Therefore, using HIFU as primary therapy for prostate cancer is unproven at this time.

Enikeev et al. (2020) conducted a prospective non-randomized study that evaluated the outcomes of whole-gland ablation (high-intensity focused ultrasound [HIFU], cryotherapy and brachytherapy) and active surveillance (AS) in patients with low-risk prostate cancer (PCa). Eligible patients had low-risk prostate cancer according to the D'Amico classification (Gleason score 3 + 3 = 6; PSA < 10 ng/ml; T1-T2a), two or less positive cores in one lobe and a prostate volume of ≤ 50 cc. The patients (n=155) were placed into four groups: HIFU (n=45), cryoablation (n=45), brachytherapy (n=35) or active surveillance (n=30). The primary outcome measured was cancer progression. The secondary outcome measured was the impact of each treatment on the quality of life. The patients underwent prostate-specific antigen (PSA) tests every three months after surgery or start of AS. Prostate multiparametric-magnetic resonance imaging (MpMRI) was repeated at 12 and 24 months. All patients, regardless of disease progression, underwent repeat prostate biopsy at 12 and 24 months. Functional parameters (IPSS, IIEF-5) and PSA levels were evaluated at three, six, 12, 18 and 24 months after surgery or start of AS. The urinary incontinence rate was assessed with the pad-test. At 12 and 24 months, all patients were assessed by the Hospital Anxiety and Depression Scale (HADS). There was not a statistically significant differences in survival rates between the groups. Biochemical relapse-free survival rates at 24 months were not statistically significant between groups: 81.8% for HIFU, 85% for cryoablation, 93.9% for brachytherapy and 93.3% for AS. Increased anxiety was found in 6.7% of patients after treatment and in 36.7% of patients undergoing AS. There was no statistical differences between the techniques. Author noted limitations included the non-randomized design, short term follow-up and small patient population.

Schmid et al. (2019) conducted a multicenter prospective cohort study that analyzed the safety and complications of high intensity focused ultrasound (HIFU) for the treatment of localized prostate cancer (CaP). Eligible patients (n=98) suffered from low to intermediate risk localized CaP with no prior treatment. After tumor identification on multiparametric MRI and by prostate biopsy, the lesions were treated with HIFU observing a safety margin of 8 to 10 mm. Adverse events (AE) and the required interventions were assessed and stratified after 30 and 90 days for treatment localizations. The primary endpoint was any AE stratified for localization of the HIFU ablation zone. The secondary endpoints were the size and location of the treated tumor within the prostate, stratified for complications and subsequent interventions. Follow-up visits occurred in the outpatient clinic after four to six weeks and after three months with assessment of PSA values and questionnaires. During this systematic follow-up regimen, the 30 and 90-day complication rate and the interventions for adverse events (AE) were documented. In the first 30 days after HIFU, 35 (35.7%) experienced AEs. Fifteen patients had a postoperative urinary tract infection, 26 patients had urinary retention and four patients underwent subsequent intervention. The number of late postoperative complications occurring between 30 and 90 days after intervention was low, with the highest complication rate associated with tumors located at the anterior base of the prostate (50.0%). The inclusion of the urethra in the ablation zone led to AEs in 20 out of 41 cases (48.8%) and represented a significant risk factor for complications within 30 days (p=0.033). Author noted limitations included the small sample size and possible selection bias. In addition, larger cohorts with long-term follow-up data are needed to better answer questions on specific complications according to treatment areas combined with the results on oncologic efficacy.

Guillaumier et al. (2018) reported the medium-term cancer control outcomes in a large prospective multicenter patient cohort with clinically significant nonmetastatic prostate cancer treated with primary focal high-intensity focused ultrasound (HIFU). Patients (n=625) underwent primary focal HIFU using a Sonablate 500 device. The study included patients diagnosed with nonmetastatic prostate cancer with a Gleason score 6–9, stage T1c–3bN0M0 and a prostate-specific antigen (PSA) of ≤ 30 ng/ml. The primary outcome measured the failure-free survival (FFS) at five years which was defined as avoidance of local salvage therapy (surgery or radiotherapy), systemic therapy, metastases, and prostate cancer-specific death. Secondary outcomes included metastasis-free survival and prostate cancer-specific mortality and overall mortality. The study also reported biopsy outcomes when carried out, as well as adverse events and side effects. Urinary continence was defined as being completely pad-free and socially continent (0–1 pads/day). Additionally, complete pad-free and leak-free urinary continence were reported. Physicians assessed postoperative adverse events during follow-up visits. Functional outcomes were assessed using validated questionnaires collected at 1–2 and 2–3 years after focal HIFU treatment. The median follow-up was 56 months. The FFS at one, three and five years was 99%, 92% and 88%, respectively. For the whole patient cohort, metastasis-free, cancer-specific and overall survival at five years was 98% 100% and 99%, respectively. Among patients who returned validated questionnaires, 241/247 (98%) achieved complete pad-free urinary continence and none required more than one pad day. Author noted limitations included the lack of long-term follow-up, not all patients were biopsied after treatment and validated questionnaire data was not available for all patients.

There is insufficient data to support HIFU as primary therapy for localized prostate cancer. Further well-designed, controlled trials a needed to establish long-term efficacy, safety and health outcomes of HIFU for primary prostate cancer treatment.

Professional Societies/Organizations

National Comprehensive Cancer Network® (NCCN®): The NCCN Clinical Practice Guidelines in Oncology Prostate Cancer stated that local therapies have been investigated for the treatment of primary and recurrent localized prostate cancer, with the goals of decreasing side effects and achieving the cancer control of other therapies. Local therapies lack long-term data when comparing these treatments to radiation or radical prostatectomy and are not recommended for routine primary therapy for localized prostate cancer. The NCCN panel recommends only cryosurgery and HIFU as local therapy for the recurrence of prostate cancer without metastasis after radiation therapy (NCCN, 2023a).

American Cancer Society (ACS): HIFU is mentioned as a newer treatment for early-stage prostate cancer. HIFU treatment has been used in some countries for a while and is now available in the United States. Studies are under way to determine its safety and effectiveness. At this time, most doctors in the US don’t consider HIFU to be a proven first-line treatment for prostate cancer (ACS, 2021).

American Urological Association (AUA)/American Society for Radiation Oncology (ASTRO): A joint guideline on clinically localized prostate cancer issued by AUA, ASTRO and endorsed by Society of Urologic Oncology (SUO) stated the following:

1. Clinicians should inform intermediate-risk prostate cancer patients who are considering whole gland or focal ablation that these interventions lack high-quality data comparing ablation outcomes to radiation therapy, surgery, and active surveillance. (Expert Opinion)
2. Clinicians should not recommend whole gland or focal ablation for patients with high-risk prostate cancer outside of a clinical trial. (Expert Opinion)

Additionally, the guideline stated that ablation can be considered in select, appropriately informed patients (with clinical trial enrollment prioritized). Patients with intermediate-risk prostate cancer can be considered for ablation while those with high-risk disease should not be considered for ablation due to lack of supporting data. Lastly, patients with low-risk cancers should be managed with active surveillance (Eastham, et al., 2022a).

American College of Radiology (ACR) Appropriateness Criteria®: The ACR's guideline on locally advanced, high-risk prostate cancer stated that HIFU is an option available for men with high-risk prostate cancer, however data is limited for this treatment modality (ACR 1996; Reviewed 2016).

Benign Prostatic Hypertrophy (BPH)
BPH is a noncancerous enlargement of the prostate gland. Symptoms of BPH include frequent urination, urgency, and excessive urination at night. Drug therapy may benefit patients with mild symptoms. Transurethral resection of the prostate has been established as the standard treatment for moderate to severe BPH. The procedure is done through a resectoscope and involves use of an electrocautery loop to remove a substantial portion of the prostate. HIFU is one of several less invasive alternatives to surgical resection of the prostate that are currently under clinical study. HIFU delivers targeted high-intensity ultrasound that rapidly elevates the temperature in a precise focal zone, thereby ablating excess prostate tissue.

Literature Review - BPH: Evidence in the published peer-reviewed medical literature evaluating HIFU for BPH consists primarily of few case series. Ohigashi et al. (2007) evaluated the efficacy and durability of three different minimally invasive therapies for BPH in a five-year prospective cohort study (n=103). Interventions were transurethral microwave thermotherapy (n=34); transurethral needle ablation (n=29); and transrectal HIFU (n=40). There were no statistical differences found in efficacy or in the durability among the three interventions.

A case series (n=150) by Lü et al. (2007) was conducted on the safety and efficacy of transrectal HIFU for BPH. Outcomes included international prostate symptom score (IPSS), quality of life (QOL), uroflowmetric findings and transrectal ultrasound and incidence of complications. At the12-month follow-up after the operation, maximum urine flow rate ($p<0.01$), post void residual ($p<0.01$) and prostatic volume ($p<0.05$) were significantly improved. However limitations of this study include its nonrandomized, uncontrolled design and short follow-up period.

Glaucoma
Glaucoma is a chronic disorder involving increased pressure in the eye due to fluid build-up. There are several forms of glaucoma with open angle glaucoma (OAG) being the most common. The increased pressure associated with OAG can lead to optic neuropathies characterized by visual field loss and structural damage to the optic nerve fiber. If left untreated, glaucoma can result in partial or complete visual impairment. Currently, intraocular pressure (IOP) is the only treatable risk factor for glaucoma, and lowering IOP has proven beneficial in reducing the progression of loss of vision. In most cases, topical or oral medication is the first treatment of choice. For patients who are unwilling or unable to use medications or are unresponsive to medications, laser therapy or trabeculectomy, may be an option. Trabeculectomy is the current standard surgical technique for reduction of IOP, but it can result in extremely low IOP, causing ocular damage. Over time, the surgery may fail due to scar formation at the drainage site. HIFU has been proposed for treatment-refractory glaucoma.

The EyeOp1® HIFU system developed by EyeTechCare, S.A. (Rillieux la Pape, France) is intended to reduce the production of aqueous humor and subsequent IOP, without the potential thermal complications of cryoablation or laser therapy. The EyeOp1®, like other ablative procedures, targets the eye tissues responsible for production of aqueous humor. The system uses miniature transducers to perform thermocoagulation of ciliary processes without affecting surrounding ocular tissue (AHRQ, 2013). The EyeOp1 has not received U.S. FDA approval.

Literature Review - Glaucoma: There is currently a paucity of evidence in the published peer-reviewed medical literature evaluating the safety and effectiveness of HIFU for treatment-refractory glaucoma. The evidence evaluating HIFU for treatment-refractory glaucoma is primarily in the form of retrospective reviews, prospective case series, observational studies, and review articles (Figus, et al., 2021; Giannaccare, et al., 2021; Giannaccare, et al., 2019; Dastiridou, et al., 2018; Deb-Joardar, et al., 2018; Graber, et al., 2018; Aptel, et al., 2016; Denis, et al., 2015). Clinical trials evaluating glaucoma treatment by cyclo-coagulation using HIFU are now underway.

Liver Cancer
Hepatocellular carcinoma (HCC) is relatively uncommon in the United States, but it is the most common primary malignancy of the liver. The only potentially curative treatments are surgical resection and liver transplantation. The majority of patients with primary or metastatic liver cancers are not suitable candidates for surgical resection at the time of diagnosis. In addition, chemotherapy and radiotherapy rarely produce a complete or sustained response in patients with advanced disease. HIFU is under investigation for the ablation of unresectable HCC.

Literature Review - Liver Cancer: HIFU for liver cancer has been evaluated primarily in case series with small patient populations. Sun et al. (2019) conducted a study that investigated the clinical efficacy of high-intensity focused ultrasound (HIFU) combined with transcatheter arterial chemoembolization (TACE) in the treatment of primary liver cancer (PLC) and its effect on the prognosis of patients. Patients (n=132) were divided into an observation group (n=68) and control group (n=54). The observation group was treated TACE and HIFU and the control group was treated with TACE alone. Included patients had a diagnoses of primary liver cancer by pathology, without any prior treatment before admission. All the 132 patients were followed up by telephone or interview every three months for three years. The outcomes measured treatment efficacy by measuring the tumor volume reduction rate, adverse events and total survival. The total effective rate of the OG was 83.82%, which was significantly higher than 55.56% of the CG ($p<0.05$). No significant difference was found in incidence of skin burns, liver function injury, nausea, and loss of appetite between the groups ($p>0.05$). After treatment, increases of CD3+, CD4+, CD4+/CD8+, and NK cells in the OG were more significant than those in the CG ($p<0.05$). At three years the survival rate of patients in the OG was 61.76%, which was significantly higher than the 40.74% in the CG ($p<0.05$). All the patients were successfully followed up and no patient was lost to follow-up. Limitations included the small sample size and the insufficient time span for survival analysis. Additionally, the correlation between other relevant clinical indicators and primary liver cancer has not been discussed in depth and should be explored further. No health disparities were identified by the investigators.

Luo and Jiang (2019) conducted a study that compared the therapeutic efficacy of transarterial chemoembolization (TACE) plus high intensity focused ultrasound (HIFU) to TACE alone on patients with primary liver cancer. Patients (n=90) were randomly divided into a control group (n=45) and an observation group (n=45). The control group was treated with TACE alone and the observation group was treated with HIFU plus TACE. Included patients had a diagnosis of liver cancer by pathology, impossibility in radical resection, no combined distant metastasis; stable vital signs, normal coagulation mechanism, normal liver and kidney functions, complete clinical data, and completing one year's postoperative follow-up. The measured outcomes were the recurrence rate of liver cancer and the frequency of complications. Follow-up occurred after six months of treatment and at one year. After six months of treatment, fasting peripheral venous blood was collected from the two groups to measure and compare changes in alpha-fetoprotein (AFP), alanine aminotransferase (ALT), aspartate amino transferase (AST), and total bilirubin (TBIL). Both groups completed a one-year follow-up survey to record recurrence and metastasis of the tumor in the form of telephone and outpatient review. The total remission rate of observation group (HIFU plus TACE) was significantly higher than that of control group (TACE alone) ($p=0.017$). At six months after treatment, AFP level in observation group (HIFU plus TACE) was significantly lower than that in control group (TACE alone) ($p < 0.001$). There was no statistical difference in liver function indicators of ALT, AST, and TBIL between two groups ($p=0.968$, 0.944 and 0.973, respectively). The incidence of digestive tract hemorrhage was lower in the observation group than that in control group ($p=0.049$). After one year of follow-up, the tumor recurrence rate and tumor metastasis rate in observation group were lower than that of control group ($p=0.036$ and 0.044, respectively). Limitations of the study include small patient population and short-term follow-up.

Luo et al. (2017) published a meta-analysis evaluating the evidence (n=30 studies) for the therapeutic effects of radiofrequency ablation compared to other ablative techniques including HIFU microwave ablation, percutaneous ethanol injection, and cryoablation on HCCs. The review consisted of cohort studies (n=14), and RCTs (n=16), with a single cohort study (n=103 patients) only referring to HIFU versus RFA. Outcomes measured were complete tumor ablation, overall survival, local tumor recurrence, and rate of complications. No obvious difference in therapeutic effects was found between HIFU and RFA. Overall survival rates were > 60% and complete tumor ablation were > 80% in both groups ($p>0.05$). Procedure-related complications were also comparable in both groups ($p=0.06$). The paucity of evidence on HIFU for HCC did not allow for meta-analysis. The authors noted that in general, additional well-designed RCTs are needed to support study results.

Li et al. (2007) compared HIFU plus supportive care (n=151) to supportive treatment alone (n=30). Tumor imaging parameters, serum AFP levels and symptom scores improved significantly in the HIFU group compared with the control group (all $p<0.05$). The one- and two-year survival rates were 50.0% and 30.9%, respectively, in the HIFU group, which were significantly greater than those (3.4% and 0%, respectively) in the control group (both $p<0.01$). No severe complications occurred during and after HIFU. Although study results suggest improved outcomes with HIFU, there are limitations which include lack of randomization and short-term follow-up.

Additional well-designed studies with larger patient populations are needed to support the safety and effectiveness of HIFU for the treatment of unresectable liver cancer.

Professional Societies/Organizations: The NCCN guideline on hepatobiliary cancer does not mention HIFU as a treatment option for liver cancer (NCCN, 2023d).

Renal Cancer

Renal cell carcinoma (RCC), also referred to as kidney cancer, is a disease in which cancer cells are found in the lining of tubules in the kidney. Approximately 90% of renal tumors are RCCs. Symptoms of RCC may include: blood in the urine, loss of appetite, pain in the side that doesn't subside, weight loss, and anemia. Standard treatment available for patients with RCC includes surgery, chemotherapy, external or internal radiation therapy, and immunotherapy. Surgical excision in the form of a partial or radical nephrectomy is the accepted, often curative, treatment for stages I, II and III of RCC (NCCN, 2023b). HIFU has been proposed as an intervention for small renal masses as well as advanced stage renal malignancy.

Literature Review - Renal Cancer: There is a paucity of studies in the published peer-reviewed scientific literature evaluating the safety and effectiveness of HIFU for renal cancer. Case series with small patient populations (n=13–17) provide preliminary, but insufficient data from which to draw conclusions (Ritchie, et al., 2011; Ritchie, et al., 2010; Wu, et al., 2003). The role of HIFU has not been established for this indication.

Professional Societies/Organizations: The NCCN guideline on kidney cancer does not mention HIFU as a treatment option for renal cancer (NCCN, 2023b).

Thyroid Nodules
Nodular thyroid tissue is common, however most thyroid nodules are benign. Causes of benign thyroid nodules include goiter and Hashimoto's thyroiditis. The incidence of malignancy, or thyroid cancer, depends on factors such as age, gender, radiation exposure, and family history. Treatment of thyroid cancer depends on the type of cancer, but may include radioiodine, thyroid hormone suppression and surgical removal of the thyroid gland. Minimally invasive treatments, such as percutaneous ethanol injection sclerotherapy, laser photocoagulation, and HIFU ablation, have been proposed as an alternative to surgery (Bandeira-Echtler, et al., 2014).

Literature Review - Thyroid Nodules: Few preliminary case series with small patient populations (n=10–65) evaluating HIFU for thyroid nodules have been reported in the medical peer-reviewed literature (Monpeyssen, et al., 2020; Lang and Wu, 2017; Korkusuz, et al., 2014; Kovatcheva, et al., 2014). These preliminary study results suggest that HIFU may be a promising non-invasive tool for nodular thyroid disease, but the available evidence is insufficient to draw conclusions regarding HIFU for this indication.

Magnetic Resonance (MR)-Guided Focused Ultrasound (MRgFUS)
MRgFUS technology combines a high intensity focused ultrasound beam that heats and destroys targeted tissue non-invasively and magnetic resonance imaging (MRI) which visualizes anatomy, and continuously monitors the tissue effect. HIFU therapy using MR-guidance has been proposed for the treatment of uterine fibroids (leiomyomata), essential tremor, metastatic bone cancer, and other tumor types, however, to date the most studied clinical application of MRgFUS has been treatment of leiomyomata.

Bone Cancer
Metastatic bone pain is a common complication of cancer. Bone metastases can cause pain, fractures, compression of the spinal cord or nerve roots, and life-threatening hypercalcemia. Surgery, radiotherapy, or medical treatment may be required to treat bone metastases. Existing treatments include supportive measures, pharmacologic agents and radiation therapy. For treating pain associated with bone metastases, magnetic resonance-guided focused ultrasound (MRgFUS) combines high-intensity focused ultrasound, for the thermal ablation of bone metastases and subsequent pain reduction, with real-time magnetic resonance (MR) thermometry (Tsukamoto, et al., 2021; Wang, et al., 2021).

U.S. Food and Drug Administration (FDA): In October 2012, the FDA granted a PMA for the ExAblate® System, Model 2000/2100/2100 VI (InSightec North America, Dallas, TX). The device is indicated for pain palliation of metastatic bone cancer in patients 18 years of age or older who are suffering from bone pain due to metastatic disease and who are failures of standard radiation therapy, or not candidates for, or refused radiation therapy. The bone tumor to be treated must be visible on non-contrast MR and device accessible. (FDA, 2012).

Literature Review - Bone Cancer: Lee et al (2017) published the results of a matched-pair study (n=63) to compare the therapeutic effects of MRgFUS (n=21) with those of conventional RT (n=42) as a first-line treatment for patients with painful bone metastasis. Patient selection criteria based on a retrospective electronic record review included the following:

- a solitary distinguishable painful bone metastasis
- no previous local therapy to the targeted bone lesion

- an unchanged schedule of systemic therapy, including chemotherapy, targeted therapy, hormonal therapy, and bone-targeted agents two weeks before and three months after the intervention with MRgFUS or RT
- survival and regular follow-up of ‡3 months after the MRgFUS or RT intervention

Patients with a Mirels score > 7, indicating impending pathological fracture, or with substantial comorbidities were excluded. The primary outcome was the clinical treatment response rate in terms of successful pain palliation at each evaluation point after either MRgFUS or RT. The secondary end points were a change in the pain score and morphine-equivalent daily dose, and treatment-related adverse events up to three months after treatment. The overall complete-response rates at three months were 43% and 29% in the MRgFUS and RT-treated patients (p=0.2729), respectively. The mean NRS pain score of the MRgFUS-treated patients was significantly lower at one week (p<0.0001), two weeks (p=0.0188), and three months (p=0.0269) after treatment than those of the RT-treated patients. Pain scores did not differ significantly at one- and two-month follow-up periods. The mean morphine-equivalent daily dose change from baseline at each evaluation point did not differ significantly between the two treatment groups. No adverse events above grade two were documented for either the MRgFUS or the RT patients. The median overall survival time was 12.7 and 9.8 months after treatment with MRgFUS and RT, respectively (p=0.6184). Acknowledged study limitations are the small sample size, retrospective design, and short follow-up time frame.

Hurwitz et al. in (2014) published results of a randomized, placebo-controlled, single-blind, multicenter trial (n=147) of MRgFUS in the palliation of pain from bone metastases. Patients were randomly assigned 3:1 to MRgFUS (n=112) or placebo treatment (n=35), which was identical to MRgFUS but with power off. The 3:1 imbalance in randomization was chosen to minimize ethical concerns with placebo treatment in this patient population. Patients included were at least 18 years old with a life expectancy ≥ three months. Treatment was performed on bone metastases that were painful despite previous RT, otherwise unsuitable for RT or if RT was declined. Patients with ≤ five painful lesions were eligible. Patients requiring surgical stabilization or with clinically significant comorbidities were excluded. The primary outcome was pain reduction after MRgFUS. Secondary outcomes included assessment of the treatment’s impact on pain-related interference with patient functioning and treatment-related toxicity. Follow-up after the intervention was not completed by 26 patients in the MRgFUS arm and 23 patients in the placebo group. Response rate for the primary endpoint was 64.3% in the MRgFUS arm and 20.0% in the placebo group (p<0.001). MRgFUS was also found to perform better than placebo on the secondary endpoints assessing worst pain score (p<0.001) and the functional interference of pain on quality of life (p<0.001) at three months of follow-up. The most common treatment-related adverse event was pain related to the procedure, which occurred in 32.1% of MRgFUS patients. Overall 60.3% of all AEs resolved on the day of treatment. The authors acknowledged and explained study limitations which included double enrollment of five patients, difference in prior RT between study groups, imbalanced randomization, and the loss at follow-up. Study results indicate that MRgFUS may be a safe and effective noninvasive treatment option for pain from bone metastases in patients that have failed standard treatments. However additional randomized controlled trials are needed to confirm these findings.

Systematic reviews with meta-analysis and case series with small patient populations (n=7–82) with follow-up from three months to five years have also evaluated the safety and effectiveness of imaging-guided HIFU for primary and metastatic bone tumors (Yin, et al., 2022; Baal, et al., 2021; Chen, et al., 2010; Li, et al., 2010). Survival rates of 89.8%, 72.3%, 60.5%, 50.5%, and 50.5%, at one, two, three, four, and five years, respectively have been reported (Chen, et al., 2010). Additional well-designed clinical trials with larger sample sizes are needed to further determine the role of HIFU for bone cancer. However, there is some evidence in the published peer reviewed medical literature to suggest that MRgFUS is safe and effective for a subset of patients with metastatic bone cancer.

Professional Societies/Organizations: National Comprehensive Cancer Network® (NCCN®): According to NCCN guidelines for adult cancer pain, ablative strategies such as image-guided ablation may also be performed to decrease both pain and the occurrence of skeletal related events (SREs). The NCCN notes that "several small studies have also demonstrated the palliative effects of HIFU treatment of bone lesions" (NCCN, 2023c).

Essential Tremor

Essential tremor (ET) is a common movement disorder characterized by postural tremor of the outstretched upper limbs that is absent at rest, not worsened by movement, and not associated with extrapyramidal or cerebellar signs. For most individuals with ET, symptoms can be managed with medication (e.g., propanolol and primidone). Approximately 10% of patients have medically refractory ET that can cause disabling tremor. If medications fail to provide adequate relief, patients with severe, chronic and medically intractable ET become candidates for deep brain stimulation or surgical interventions (e.g., thalamotomy and pallidotomy). The surgical procedures are generally effective, but also carry the risks of open neurosurgery.

The clinical rating scale for tremor (CRST) is a scoring system that evaluates the severity of essential tremor. The CRST has three parts. Part A evaluates the tremor, Part B evaluates task performance, and Part C evaluates the disability due to the tremor. The three parts have a total of 160 points; higher scores reflect a more severe tremor. A score of two or more on the postural or action item of the CRST (ranging from 0–4), as well as substantial disability in the performance of at least two daily activities from the disability subsection of the scale reflects moderate to severe tremor (Sinai, et al., 2019; Mohammed, et al., 2018).

The Exablate Neuro has been proposed as technique used to perform a non-invasive thalamotomy by destroying tissue within the Vim nucleus of the thalamus which enables an accurate and controlled thermal effect. Ultrasound energy is delivered across the skull, without an incision or craniotomy. The treatment is done with mild sedatives over several hours and is reported to be generally well tolerated.

A multidisciplinary team evaluation at a specialized center should be done prior to MRgFUS unilateral thalamotomy or DBS. The multidisciplinary team generally includes a movement disorders neurologist, a functional neurosurgeon, and a neuropsychologist. A psychiatrist, speech therapist, physical therapist, occupational therapist, nurse, and social worker can also be on the team.

The goals of the multidisciplinary evaluation are to:

- Confirm the diagnosis of ET
- Make sure the patient has undergone adequate medication trials
- Assess surgical risk
- Screen for cognitive impairment and dementia
- Educate the patient on realistic expectations as well as risks of the procedure

If the patient is felt to be appropriate for surgery, the team would then discuss the type of surgery to perform. The decision of to use either DBS or thalamotomy should be individualized and must take into consideration the risk of complications compared with ongoing stimulator monitoring and programming adjustments (Chou and Tarsy, 2022).

U.S. Food and Drug Administration (FDA): In July 2016, the FDA granted a PMA for the ExAblate Model 4000 Type 1.0 System (i.e., ExAblate Neuro) (InSightec—North America, Dallas, TX). The device is indicated for the unilateral thalamotomy treatment of idiopathic essential tremor patients with medication-refractory disease. Patients must be at least 22 years of age. The designated area in the brain responsible for the movement disorder symptoms (i.e., ventralis intermedius) must be identified and accessible for targeted thermal ablation by the ExAblate device.

On December 16, 2018, the ExAblate Model 4000 received FDA PMA supplemental approval (P150038/S006). The device is indicated for the unilateral thalamotomy treatment of tremor-dominant Parkinson's disease with medication-refractory tremor. Patients must be at least age 30.

On October 29, 2021, the ExAblate Model 4000 received FDA PMA supplemental approval (P150038/S014). The device is indicated for use in the unilateral pallidotomy of patients with advanced, idiopathic Parkinson's disease with medication-refractory moderate to severe motor complications as an adjunct to Parkinson's disease medication treatment. Patients must be at least age 30.

Literature Review - Essential Tremor

ExAblate Transcranial MR Guided Focused Ultrasound for the Treatment of Essential Tremors FDA Post Approval Study (NCT01827904): Elias et al. (2016) published the results of a randomized controlled trail (RCT) that evaluated the effectiveness of HIFU for the treatment of essential tremor. Included patients (n=76) had a diagnosis of moderate-to-severe essential tremor that was confirmed by a neurologist or neurosurgeon specializing in movement disorders and the essential tremor had not responded to at least two trials of medical therapy. Patients were randomized in a 3:1 ratio to undergo unilateral focused ultrasound thalamotomy (n=56) or a sham procedure (n=20). The primary outcome was the between-group difference in the change in hand tremor from baseline to three months, at which time patients in the sham-procedure group were allowed to cross over to active treatment (open-label extension phase). The secondary outcomes were measured in the HIFU thalamotomy group at 12 months and included functional limitations in daily activities, quality of life, and the durability of the reduction in hand tremor. At three months, a statistically significant improvement in hand-tremor scores was found after HIFU thalamotomy versus after the sham procedure ($p<0.001$). Assessments of disability and quality of life at three months also demonstrated improvement with active treatment compared to the sham procedure ($p<0.001$). The improvement in the thalamotomy group was maintained at 12 months. Adverse events in the thalamotomy group included gait disturbance in 36% of patients and paresthesia or numbness in 38%, which persisted at 12 months in 9% and 14% of patients, respectively. A total of 21 participants (19 assigned to the sham procedure group who crossed over to thalamotomy and two assigned to thalamotomy in whom the procedure was incomplete) were treated after the three-month blinded assessment period. Limitations of the study include small sample size and a lack of comparison to standard treatment (e.g., deep brain stimulation). Additional data from well-designed RCTS are needed to support the use of MRgFUS for essential tremor.

Chang et al. (2018) published the two-year results of the open-label extension phase conducted by Elias et al. (2016). Follow-ups were conducted at six, 12 and 24 months. Seventy patients were included in the analysis at the one-year follow-up, and 67 patients were analyzed at the two-year follow-up. Mean hand tremor score at baseline improved by 55% at six months, 53% at 12 months and 56% at two years ($p<0.001$). Similarly, the disability score at baseline improved by 64% at six months and the improvement was sustained at one year. At two years, mean score was 60% ($p<0.001$). Paresthesias and gait disturbances were the most common adverse effects at one year with no new complications at two years. Author noted limitations included differences and discrepancies between these findings and the previous report specifically, the number of reported patients was different; 56 subjects in the previous report were compared to the 20 sham-treated patients, but here all 76 patients were analyzed. Additionally, the follow-up was two years here versus one year and nine patients dropped out of the study by two years. The authors concluded that tremor suppression after MRgFUS thalamotomy for ET is stably maintained at two years. However, additional follow-up is needed to determine the incidence of recurrence and the efficacy of MRgFUS over the long term.

Halpern et al. (2019) published the three-year results of the of the open-label extension study by Elias et al. (2016). The study assessed the effectiveness, durability, and safety of transcranial magnetic resonance-guided focused ultrasound (tcMRgFUS) thalamotomy for patients with medication refractory essential tremor (ET). Of the 75 treated patients, 67 were observed at six months, 70 at 12 months, 50 at 24 months, and 52 at 36 months. Overall, the three-year attrition from the treated patient cohort is 31%, with a loss of 23 patients. The outcomes at 36 months were compared with baseline and at six months after treatment to assess for efficacy and durability. Outcomes were based on the Clinical Rating Scale for Tremor, including hand combined tremor-motor (scale of 0 to 32), functional disability (scale of 0 to 32), postural tremor (scale of 0 to 4), and total scores from the QOL in Essential Tremor Questionnaire (scale of 0 to 100). Additionally, adverse events were reported. All measured scores remained improved from baseline to 36 months ($p<0.0001$). The range of improvement from baseline was 38%–50% in hand tremor, 43%–56% in disability, 50%–75% in postural tremor, and 27%–42% in quality of life. When compared to scores at six months, median scores increased for hand tremor ($p=0.0098$) and disability ($p=0.0001$). During the third-year follow-up, all previously noted adverse events remained mild or moderate, none worsened, two resolved, and no new adverse events occurred. Author noted limitations included the high dropout rate and the patient analysis differed from the cohorts present in the original RCT and the two-year follow-up.

Cosgrove et al. (2022) published the four- and five-year results of the of the open-label extension study by Elias et al. (2016). The study assessed the effectiveness, durability, and safety of transcranial magnetic resonance-guided focused ultrasound (tcMRgFUS) thalamotomy for patients with medication refractory essential tremor (ET). Of the 75 treated patients, 45 were observed at four years and 40 at five years. Of the 40 patients who completed the five-year follow-up, 30 were male and 10 were female; 29 were White and 11 were Asian. Outcomes were based on the Clinical Rating Scale for Tremor (CRST), including hand combined tremor-motor (scale of 0 to 32), functional disability (scale of 0 to 32), postural tremor (scale of 0 to 4), and total scores from the QOL in Essential Tremor Questionnaire (scale of 0 to 100). Additionally, adverse events were reported. CRST scores for postural tremor remained significantly improved by 73.3% and 73.1% from baseline at both 48- and 60-months posttreatment, respectively (both $p<0.0001$). Combined hand tremor/motor scores also improved by 49.5% and 40.4% ($p<0.0001$) at each respective time point. Functional disability scores increased slightly over time but remained significantly improved through the five years ($p<0.0001$). Similarly, QUEST scores remained significantly improved from baseline at year 4 ($p<0.0001$) and year 5 ($p<0.0003$). There were no serious AEs recorded at five years. All adverse events at the four- and five-year follow-ups were classified as mild (71%) or moderate (29%) by the study investigators. There were no new AEs related to or probably related to the procedure from the 12-month time point to the last follow-up at 5 years. Author noted limitation included the loss of patient follow-up at four and five years. However, only one of the seven patients who exited the study at the fourth year had an alternative treatment (DBS); all others left because of concomitant unrelated health issues and an inability to travel because of the coronavirus disease 2019 outbreak. The authors concluded that unilateral MRgFUS thalamotomy demonstrated sustained and significant tremor improvement at five years with an improvement in quality-of-life and without any progressive or delayed adverse events.

Non-Randomized Studies: Purrer et al. (2022) conducted a cohort study that analyzed the clinical outcomes of patients treated with tcMRgFUS for medication-refractory ET. Patients (n=45) with confirmed, severe, medication-refractory ET underwent treatment with tcMRgFUS thalamotomy. Included patients had moderate to severe tremor (score of ≥ 2 in the dominant hand on the Clinical Rating Scale for Tremor [CRST]) which affected daily activities and/or QoL (score >2 in the disability suspicion of the CRST or ≥30% self-rated reduction of QoL caused by the tremor) with failure of two medication trials. The patients were assessed by two neurologists before treatment (T0) and 1–3 days after treatment (T1). Follow-up occurred at one (T2), six (T3), and 12 months (T4) after tcMRgFUS. Outcomes measured tremor severity, disability and quality of life using the Clinical Rating Scale for Tremor (CRST), surface electromyography, the Quality of Life in were measured using the Clinical Rating Scale for Tremor (CRST), surface electromyography, the Quality of Life in Essential Tremor Questionnaire (QUEST) and the Short-Form-36 questionnaire (SF-36). Depressive symptoms and cognitive function were assessed using standardized questionnaires. Electrophysiological measurements were conducted to evaluate possible effects on central motor and sensory pathways. The authors reported that one year after tcMRgFUS the mean tremor improvement was 82%. Additionally, mental quality of life improved, especially in activities of daily living and psychosocial function. There was no worsening of cognitive function within the self-rating questionnaire; no prolongation of sensory evoked potentials or central motor conduction time occurred. Side effects were mostly classified as mild (78%) and transient (62%) and included gait disturbances (57%), paraesthesias (41%), taste disturbances (43%), impairment of extremity coordination (11%) or reported involuntary movements of the contralateral limb (41%). Author noted limitations included lack of control group and the unblinded study design. Additionally, four patients were lost to follow-up which could cause bias and overestimation of positive tremor benefit. The authors concluded that tcMRgFUS is a treatment option in severe drug-resistant tremor and has a positive impact on QoL and non-motor symptoms. No health disparities were identified by the investigators.

Harary et al. (2019) compared two controlled trials that evaluated unilateral thalamic deep brain stimulation (DBS) and focused ultrasound thalamotomy (MRgFUS) for the treatment of refractory essential tremor. In the DBS single-blinded trial, patients received unilateral or bilateral DBS implantation targeting the Vim with the Brio Neurostimulation constant-current stimulation device (Wharen, et al., 2017). The MRgFUS double-blinded controlled trial patients were randomized to either unilateral MRgFUS Vim thalamotomy using the ExAblate Neuro model 4000 type 1.0 system (Insightec Inc., Dallas, Texas, USA) or sham surgery (Elias et al., 2016). Clinical outcomes measured postural tremor score in the treated upper extremity, quality of life (QoL) and the incidence of adverse events (AE). Author noted limitations included the difference in baseline patient characteristics between the two trials in terms of age and tremor severity, and the exclusion of a significant number of patients from the primary outcome reporting in the DBS trial. Additionally, there was not enough data available to make statistical comparison for all outcome metrics. At baseline patient characteristics were comparable, except that DBS patients were younger and had more severe baseline tremor. Both DBS and MRgFUS-treated patients had significant tremor improvement ($p<0.001$) that was sustained for one year posttreatment and significant improvement in QoL. The post treatment scores were comparable between groups at each follow-up ($p>0.40$). The MRgFUS cohort had higher rates of persistent neurologic AE, whereas the DBS group had higher rates of surgery- and hardware related AEs, including intracranial hemorrhage. The study concluded that both DBS and MRgFUS significantly improve tremor control and QoL. The two approaches are differentiated by their adverse events profile. Additional, well-designed studies are needed to determine clinical efficacy and long-term outcomes of MRgFUS when compared to DBS. No health disparities were identified by the investigators.

Mohammed et al. (2018) published the results of a meta-analysis evaluating the outcomes and complications of magnetic resonance–guided focused ultrasound (MRgFUS) in the treatment of essential tremor (ET). Nine studies with 160 patients who had ET were included in the meta-analysis. One randomized controlled trial, six retrospective studies, and two prospective studies were included in the review. The aim of the study was to analyze the outcome of MRgFUS therapy in the treatment of ET. The outcome parameters analyzed were changes in the Clinical Rating Scale for Tremor (CRST) score and improvement in quality of life and disability following treatment using the Quality of Life in Essential Tremor Questionnaire (QUEST) score. The included studies evaluated the presence of a visible and present bilateral postural tremor of the hands and forearms, lasting for more than five years, confirmed diagnosis of ET and treated with MRgFUS. The included cases were refractory to medical therapy. Medication-refractory tremor was defined as a persistent disabling tremor despite at least two trials of a full-dose therapeutic medication, one of which had to include propranolol or primidone. On meta-analysis, the pooled improvement in the CRST Total, CRST Part A, CRST Part C, and QUEST scores were 62.2%, 62.4%, 69.1%, and 46.5%, respectively. The improvement in the score reflects the reduction in the severity and associated disability due to the tremor. The most common complications that occurred during the procedure were headache along with nausea and vomiting occurring in 43.4% and 26.8%, respectively. At three months the most common complication was Ataxia occurring in 25.1% of patients. At 12 months, paresthesias became the most common persisting complaint (15.3%) with ataxia completely resolving in a majority of patients. Limitations of the study include short term follow-up, small patient population, and the included studies were primarily retrospective.

Professional Societies/Organizations

American Society for Stereotactic and Functional Neurosurgeons (ASSFN): In 2018, the ASSFN published a position statement on MR-guided Focused Ultrasound for the Management of Essential Tremor. The ASSFN recommended MRgFUS as a treatment option for patients with essential tremor when the following criteria is met:

- patient has a confirmed diagnosis of ET
- patient fails to respond to, has intolerance of, or medical contraindication to use of at least two medications for ET, one of which must be a first line medication
- patient with appendicular tremor that interferes with quality of life based on clinical history
- treatment is unilateral

The ASSFN stated that MRgFUS can be considered for patients who can provide informed consent, understand the benefits, risks, and alternatives, tremor results in significant functional impairments based on clinical history, and treatment is anticipated to result in significant functional improvement. The procedure should be performed by physicians with expertise in functional and stereotactic neurosurgery, who are specifically experienced in working with and qualified to surgically manage patients with medically refractory essential tremor. Lastly, physicians need to have received specific training in MRgFUS before performing the procedure (Pouratian, et al., 2020).

Uterine Fibroids

Uterine leiomyomata, or fibroids, are benign tumors of the uterus that are made up of smooth muscle and the extracellular matrix proteins, collagen and elastin. Fibroids can lead to abnormal uterine bleeding, dysmenorrhea and noncyclic pelvic pain. They can also cause constipation, urinary frequency, and infertility, depending on their size and location. The current standards of care for the treatment of symptomatic fibroids include:

- nonsteroidal anti-inflammatory agents
- oral contraceptives
- pharmacological agents (gonadotropin-releasing hormone [GnRH]) for short-term therapy
- myomectomy (laparoscopic or open)
- uterine artery embolization
- hysterectomy

Myomectomy and uterine artery embolization are surgical options for patients who wish to preserve their fertility, since a hysterectomy would render these individuals permanently infertile.

MRgFUS has been proposed as a non-invasive technique used to ablate uterine fibroids in women who do not intend to become pregnant in the future. Although early studies showed that some fibroid symptoms decreased (n=71%) following the procedure, a high percentage of patients (n=21%) needed alternative surgical treatment for their fibroids within one year of having the procedure because their previous symptoms returned. Reported adverse effects of MRgFUS have included paresthesia, burns on the abdomen, excessive postoperative bleeding and reactions to medication.

U.S. Food and Drug Administration (FDA): In November 2004, the FDA granted premarket approval (PMA) for an MRgFUS system for the proposed targeting and destruction of symptomatic fibroids. The ExAblate® 2000 System (InSightec—North America, Dallas, TX) is indicated for the ablation of symptomatic fibroids in women who have completed childbearing, do not intend to become pregnant, and have a uterine gestational size of less than 24 weeks. The ExAblate 2000 is contraindicated for use in women who have:

- MRI-related issues, such as metallic implants or sensitivity to MRI contrast agents
- obstructions in the treatment beam path, such as a scar, skin folds or irregularity, bowel, pubic bone, intrauterine device (IUD), surgical clips, or any hard implants
- fibroids that are close to sensitive organs, such as the bowel or bladder, or are outside the image area

Literature Review - Uterine Fibroids: Studies in the published peer-reviewed scientific literature evaluating the safety and effectiveness of MRgFUS ablation of uterine fibroids consists primarily of case series with few comparative trials.

Yerezhepbayeva et al. (2022) conducted a systematic review that compared the safety and effectiveness of uterine artery embolization (UAE) and magnetic resonance guided high intensity focused ultrasound (MRgHIFU) in treating uterine myomas. This systematic review comparing the percent fibroid volume shrinkage immediately after the procedure and after three, six, 12 and 24 months and compared common complications following treatment. Studies with premenopausal patients with previous treatments for uterine leiomyoma and/or with other pelvic diseases were excluded. Fourteen case series (n=1383 patients) reported on UAE treatment outcomes and 15 reported MRgHIFU (n=835 patients) treatment outcomes. The authors reported that the weighted fibroid volume percent shrinkage after UAE was statistically significantly greater than MRgHIFU at six, 12 and 24 month's post procedure (p=0.0001 for all). However, UAE had statistically significantly more complications, such as pain, nausea and vomiting. The study concluded that the study cannot conclude that UAE is more effective than MRgHIFU and Randomized controlled trials, are needed to further validate the findings of this study. No health disparities were identified by the investigators.

In 2022, Laughlin-Tommaso et al. reported the sub-analysis of the Fibroid Interventions: Reducing Symptoms Today and Tomorrow (FIRSTT) randomized controlled trial (Laughlin-Tommaso et al., 2019) that included the imaging results up to 36 months after UAE or MRgFUS. Magnetic resonance imaging (MRI) was performed at baseline for all women and during the 36 months after treatment if they did not meet other study endpoints. The outcome of this sub-analysis measured fibroid volume reduction (in terms of total fibroid load and volume of the largest fibroid), uterine volume reduction, and nonperfused volume. Twenty-five out of the 37 women that were randomized and treated had a 24-month follow-up MRI (n=11 UAE; n=14 MRgFUS); among these women, 15 (n=7 UAE; n=8 MRgFUS) had a 36-month follow-up MRI. The study reported that nine patients had a second fibroid procedure by 36 months (n=7 MRgFUS; n=2 UAE). Median total fibroid load reduction was approximately 50% in both treatment arms at both 24- and 36-month follow-up. Statistical significance was not reached at either 24 or 36 months in changes in total fibroid load, volume of largest fibroid, or uterine volume between treatment groups. The authors concluded that similar fibroid volume reduction was seen for the MRgFUS and UAE treatments however at 24 months nonperfused volume was higher in the UAE arm than in the MRgFUS arm which did not correlate with decrease in fibroid volume in either group. The authors noted that the women in this analysis were also primarily white, which may limit generalizability.

Gao et al. (2021) published a meta-analysis of the evidence (n=11 studies/3646 patients) evaluating the safety and effectiveness between uterine artery embolization (UAE; n=498 patients), surgery (n=1602 patients) and high intensity focused ultrasound (HIFU; n=1546 patients) in the treatment of uterine fibroids. The analysis included RCTs (n=9 studies), prospective cohort study (n=1 studies) and a comprehensive cohort design with a randomized controlled trial (n=1 studies). The outcomes measured: health related quality of life (HR-QOL), major complications, minor complications, hospital stay, recovery time and further intervention rate within 1 year after treatment. When compared to surgery, UAE and HIFU patients had higher quality of life (1-year follow-up) improvement, with UAE patients reporting a slightly higher quality of life than HIFU patients. Patients treated with HIFU had the lowest incidence of major complications within one year, followed by UAE, and the highest surgery. Patients treated with HIFU and UAE have shorter hospital stays and quicker recovery time than surgery. The rate of further intervention after surgery treatment is lower than that of UAE and HIFU. The authors concluded that UAE has the highest quality of life improvement (one year follow-up) for uterine fibroids. HIFU and UAE are safer with shorter hospital stays and quicker recovery time compared with surgery. However, both UAE and HIFU have the risks of re-treatment. Additional RCTs with higher quality and larger patient population should be conducted to validate the findings of this study. No health disparities were identified by the investigators.

Xu et al. (2021) conducted a meta-analysis that compared the re-intervention rates of myomectomy, uterine artery embolization (UAE) and magnetic resonance-guided focused ultrasound surgery (MRgFUS) for uterine fibroids (UFs) at 12months, 24 months, 36 months and 60 months. The meta-analysis evaluated 31 studies that included six randomized controlled trials and 25 cohort studies. Additionally, 18 studies were from Europe, (58.1%), nine studies from USA (29.0%), three studies from Japan (9.7%) and one study from Israel (3.2%). The primary outcome measured the re-intervention rate of MRgFUS, UAE and myomectomy at 12-months, 24-months, 36-months and 60 months. The meta-analysis reported the 12-month re-intervention rates of myomectomy, UAE and MRgFUS for UFs were 6%, 7% and 12%, respectively. The 24-month re-intervention rates were 10%, 8% and 14%, respectively. The 36-month re-intervention rates were 9%, 14% and 22%, respectively. Lastly, the 60-month re-intervention rates were 19%, 21% and 49%, respectively. The authors concluded that the myomectomy had the lowest re-intervention rate of the three regimens in the short and long term while the MRgFUS has the highest re-intervention rate. The rate of MRgFUS increased rapidly at 60 months post treatment. No health disparities were identified by the investigators.

Laughlin-Tommaso et al, (2019) conducted a randomized controlled trial (RCT), Fibroid Interventions: Reducing Symptoms Today and Tomorrow (FIRSTT), with a parallel observational cohort which compared the effectiveness of magnetic resonance imaging-guided focused ultrasound surgery (MRgFUS) and uterine artery embolization (UAE). Premenopausal women with symptomatic uterine fibroid tumors were included if they were age ≥ 25 years, had no evidence of high-grade squamous intraepithelial lesions, were able to give informed consent and attend all study visits. Patients (n=49) in the randomized control trial were randomly assigned to receive MRgFUS (n=27) using the ExAblate 2000 system or UAE (n=22). Women (n=34) who declined randomization were enrolled in a parallel observational cohort to receive MRgFUS (n=16) or UAE (n=18). A comprehensive cohort design was used for outcomes analysis and included 43 patients for MRgFUS and 40 for UAE. The primary outcome measured for additional interventions, including hysterectomy, myomectomy, UAE, or MRgFUS, for symptomatic fibroid tumors within 36 months. The secondary outcomes compared quality of life, pain, fibroid symptom scores and assessed the effect of treatment of ovarian reserve which was measured using serum anti-Müllerian hormone (AMH) levels. The risk of reintervention was higher with MRgFUS than uterine artery embolization (p=0.047). Uterine artery embolization showed a significantly greater absolute decrease in anti-Müllerian hormone levels at 24 months compared to MRgFUS (p=0.03). Quality of life and pain scores improved in both arms but to a greater extent in the uterine artery embolization arm (p=0.006). Higher pretreatment AMH level and younger age at treatment increased the overall risk of reintervention. Author noted limitations included the small patient population, not all patients completed questionnaires during follow-up visits and the MRgFUS device used throughout the study has now been superseded by newer technology. The authors concluded that there is a lower reintervention rate and greater improvement in symptoms following uterine artery embolization, although some of the effectiveness may come through impairment of ovarian reserve.

Barnard et al (2017) published the results of a randomized controlled trial (RCT) and comprehensive cohort analysis which compared periprocedural outcomes of fibroid uterine artery embolization (UAE) and focused ultrasound (MRgFUS) in premenopausal women with symptomatic uterine fibroids. Women were included in the study if they were premenopausal with symptomatic fibroids, at least 25 years old, uteri less than 20 gestational weeks in size and not actively trying for pregnancy. The patients in the RCT (n=49) were randomly assigned to receive UAE (n=22) or MRgFUS (n=27). Whereas patients in the non-randomized PC1 group (n=34), were treated with UAE (n=18) or MRgFUS (n=16). The two treatment groups were analyzed using a comprehensive cohort design (CCD) which combined the RCT group and the PC1 group by treatment type UAE (n=40) or MRgFUS (n=43). The objective of the study was to summarize treatment parameters, compare recovery trajectory and adverse events in the first 6 weeks following treatment. A total of eight patients were lost to follow-up. Post procedure pain and the increased use of opioids and nonsteroidal anti-inflammatory medications were significantly higher after uterine artery embolization when compared to the focused ultrasound group (p=0.002; p<0.001; p<0.001, respectively). Furthermore, the embolization group had a significantly longer median recovery time (p<0.001) and missed more days of work (p=0.02). There were no significant differences in the incidence or severity of adverse events between treatments. Author noted limitations included: small patient population, (specifically a low enrollment of black patients), short-term follow-up, the unblinded nature of the study, lack of randomization across groups and the system used for MRgFUS (ExAblate 2000) was older than what is currently used (ExAblate 2100).

Ji et al. (2017) published a meta-analysis of the evidence (n=16 studies/1725 women) evaluating the treatment of symptomatic uterine fibroids with HIFU (n=878 patients) compared to other approaches (e.g., mifepristone, myomectomy or hysterectomy [MYC/HRM], radiofrequency ablation) (n=847 patients). The analysis included RCTs (n=11 studies), retrospective control (n=2 studies) and an unknown study category (n=2 studies). Response rate was the primary endpoint. All included studies defined complete response as the disappearance of fibroids and patient symptoms, or the reduction of fibroids volume by more than 80%. Partial response was defined as the reduction of fibroids volume from 20 to 79%, and symptom relief. Secondary outcomes included significant clinical complications or adverse events. In the overall analysis, the completely or partial response rate was not found to be significantly higher than other methods. However, the response rate for subgroup analysis by different comparison groups, was significantly higher than mifepristone (p=0.00), significantly lower than radiofrequency ablation (p=0.03), and comparable to MYC/HRM (p=0.12). The overall difference in the rates of complications or adverse events (e.g., pain/discomfort, fever, transfusion) was found to be significant (p=0.00) in favor of HIFU compared to traditional surgery or medical treatment. Limitations of this review include the small sample sizes and overall poor quality of studies. Although the results of this meta-analysis suggest that HIFU may be an effective treatment alternative for uterine fibroids, additional larger, well designed, RCTs are needed to validate these findings.

The Agency for Healthcare Research and Quality (AHRQ) published a comparative effectiveness review on the management of uterine fibroids. The review evaluated six studies which assessed HIFU for fibroid ablation, but only one study used magnetic resonance imaging (MRI) guidance. The authors concluded that although HIFU reduced fibroid and uterine size, the evidence was low due to short term follow-up and poor study design. Furthermore, the evidence related to patient reported outcomes was insufficient (Hartmann, et al., 2017).

Although some of the available data suggest that MRgFUS holds promise, the role of this procedure in the management of patients with fibroids has not been established at this time.

Professional Societies/Organizations
American College of Obstetricians and Gynecologists (ACOG): The ACOG practice bulletin on the management of symptomatic uterine leiomyomas stated that "limited, low-quality data suggest that magnetic resonance-guided focused ultrasound and high-intensity focused ultrasound are associated with a reduction in leiomyoma and uterine size". However, based on the current evidence, ACOG is unable to recommendation the use of this treatment until additional data is received (ACOG, 2021).

Magnetic resonance imaging (MRI)-guided transurethral ultrasound ablation (TULSA)
Magnetic resonance imaging (MRI)-guided transurethral ultrasound ablation (TULSA) ablates the prostate tissue using in-bore real-time MRI treatment planning, monitoring, visualization, and active temperature feedback control. The system used for the procedure is the TULSA-PRO which combines real-time Magnetic Resonance (MR) imaging and MR thermometry with transurethral directional ultrasound and closed-loop process control software to deliver thermal ablation of a customized volume of physician prescribed prostate tissue. The system consists of both hardware and software components (FDA, 2019).

U.S. Food and Drug Administration (FDA): On July 16, 2019, the FDA granted 510(k) marketing clearance for the TULSA-PRO System (Profound Medical Inc., Ontario, Canada). The TULSA-PRO System is indicated for transurethral ultrasound ablation (TULSA) of prostate tissue (FDA, 2019). On 9/16/2020 FDA granted marketing clearance for the modified TULSA-PRO® system with updated software stating that it is identical to the cleared TULSA-PRO system with the same indication.

Literature Review: Magnetic resonance imaging (MRI)-guided transurethral ultrasound ablation (TULSA) has been proposed for the treatment of prostate cancer. Currently, there is a lack of evidence supporting the effectiveness of the MRI-Tulsa/TULSA-PRO. The safety and efficacy have not been proven through well-designed clinical trials and the data lacks comparison to other well-established forms of therapy.

Klotz et al. (2020) conducted a prospective, multi-center, single-arm study (TACT) that evaluated the safety and efficacy of a magnetic resonance imaging (MRI)-guided transurethral ultrasound therapy system (TULSA-PRO) for patients with localized, organ-confined prostate cancer. Men (n=115) with favorable to intermediate risk prostate cancer across 13 centers were treated with whole-gland ablation, sparing the urethra and apical sphincter. The measured outcomes at 12-months were safety and efficacy. The study reported a median treatment delivery time of 51 minutes with 98% thermal coverage of target volume and spatial ablation precision of ±1.4 mm on MRI thermometry. Nine men (8%) had Grade 3 adverse events. The primary endpoint (FDA mandated) of PSA reduction ≥ 75% was achieved in 110 of 115 (96%) with median PSA reduction of 95% and nadir of 0.34 ng/ml. Median prostate volume decreased from 37 to 3 cc. Of the 68 men with pre-treatment Grade Group 2 (GG2) disease, 52 (79%) were free of GG2 disease on 12-month biopsy. Among 111 men with 12-month biopsy data, 72 (65%) had no evidence of cancer. Erections (IIEF Q2 ≥ 2) were maintained/regained in 69 of 92 (75%) men. The authors concluded that MRI-guided transurethral ultrasound whole-gland ablation in men with localized prostate cancer demonstrated effective tissue ablation and PSA reduction with low rates of toxicity and residual disease. However, further long-term studies with large patient populations are needed to validate the findings in this study.

Anttinen et al. (2020) conducted a prospective, single-center phase I study that evaluated the safety and early functional and oncological outcomes of salvage magnetic resonance imaging-guided transurethral ultrasound ablation (sTULSA) in men with localized radiorecurrent PCa. Men (n=11) presenting with localized, histopathologically verified, radiorecurrent PCa were eligible for the study. All patients underwent pelvic 3-T mpMRI and F-labeled PSMA ligand 1007 (F-PSMA-1007) PET-computed tomography (CT) within three months before sTULSA to confirm disease was organ-confined. After imaging, each patient also underwent pre-TULSA biopsy and a cystoscopy. Treatment was delivered using TULSA (TULSA-PRO, Profound Medical Inc., Mississauga, Canada). Three patients received whole gland (WG) ablation and eight patients underwent partial ablation. Follow-up visits were scheduled at 1–2 weeks following treatment and then every three months until 12 months. At every follow-up visit the following were assessed: adverse events, PSA, uroflowmetry, functional questionnaires, International Prostate Symptom Score [IPSS], IPSS quality of life and International Index of Erectile Function [IIEF]-5). Disease control was assessed at one year using mpMRI and 18F-PSMA-1007 PET-CT, followed by prostate biopsies. Biochemical recurrence (BCR) was assessed using the Phoenix criteria. Patients underwent cystoscopy at 12 months to assess the effect of treatment. One grade 3 and three grade 2 AEs were reported, related to urinary retention and infection. Patients experienced minor impacts on functional outcomes, the most significant was a 20% worsening of irritative/obstructive symptom scores. Compared to baseline, the declines in average flow rate and maximum flow rate at 12 months were 27% and 24%, respectively. The median decrease in voided volume from baseline to 12 months was 54%. At 1 year, 10/11 patients were free of any PCa in the targeted ablation zone, with two out-of-field recurrences. Author noted limitations include the nonrandomized design, limited sample size, and short-term oncological outcomes. The authors concluded that sTULSA appears to be safe and feasible for ablation of radiorecurrent PCa. However, additional studies with larger populations and longer follow-up are needed to validate the efficacy of this treatment.

Chin et al. (2016) conducted a prospective phase I clinical trial that evaluated the clinical safety and feasibility of MRI-TULSA for whole-gland prostate ablation for primary treatment of localized prostate cancer (PCa). Patients (n=30) aged 65 years or older were enrolled in the study if they met the following criteria: biopsy-proven organ confined PCa (clinical stage T1c–T2a, N0, M0), PSA ≤ 10 ng/ml, and Gleason score (GS) 3 + 3 or 3 + 4. All patients received MRI-TULSA using the TULSA-PRO investigational device (Profound Medical Inc., Toronto, Canada). Safety outcomes were assessed independently by either a study nurse or urologist, using Common Terminology Criteria for Adverse Events v.4. Feasibility was evaluated quantitatively because the accuracy and precision of generating a thermal volume of acute ablation conformed to the planned target prostate volume. Exploratory measured outcomes were PSA, quality-of-life questionnaires, MRI at 12 months, and 12-core (minimum) transrectal ultrasound (TRUS) prostate biopsy at 12 months. Follow-up visits occurred at two weeks, one, three, six, and 12 months after treatment. Suprapubic catheter (SPC) was removed at the two week follow-up after a successful voiding trial. Maximum temperature distribution measured during treatment depicted a continuous region of thermal ablation shaped to the target prostate volume with spatial accuracy and precision of 0.1±1.3 mm. Adverse events included hematuria (43% grade (G) 1; 6.7% G2), urinary tract infections (33% G2), acute urinary retention (10% G1; 17% G2), and epididymitis (3.3% G3). There were no rectal injuries. Median pretreatment quality of life score was eight and decreased to six at three months. Median pretreatment erectile function was 13 and remained 13 at 12 months.

Median PSA decreased by 87% at one month and 12 months at 0.8 ng/m. Positive biopsies showed a 61% reduction in total cancer length, clinically significant disease in nine of 29 patients and any disease in 16 of 29 patients. Author noted limitations of the study included the small sample size and short-term follow-up, although the phase one safety, feasibility, and exploratory clinical end points were achieved. Additionally, oncologic outcomes were not the primary or secondary end point of this phase I study, and thus no meaningful conclusion can be made. The authors concluded that further study of MRI-TULSA with a wider PCa patient population and reduced safety margins is warranted.

Nair et al. (2020) reported the 3-year results for the prospective phase I clinical trial that was previously reported on by Chin et al. (2016). By three years, 22 of the 30 patients remained on protocol mandated follow-up including all 13 patients who had negative 12-month biopsies. One patient withdrew from the study after refusing the 12-month biopsy with an undetectable PSA level, and seven had received subsequent treatment without complications. Of the seven patients' positive for insignificant disease at the 12-month biopsy, four underwent salvage radical prostatectomy (RP). Patients who had clinically significant disease at 12-months (n=9), five received salvage treatment. Urinary and bowel function along with erectile functioning remained stable at 3 years. Serial biopsies identified clinically significant disease in 10/29 men (34%) and any cancer in 17/29 (59%). Biochemical recurrence (BCR) was observed in eight patients, with an estimated three-year BCR-free survival of 74% with an estimated salvage-free survival rate of 76% at three years. Author noted limitations included that the treatment plan was not defined with oncological intent, leading to higher rates of biochemical and histological failure than would be expected in the routine use of TULSA. As a result, the present study was neither designed nor powered to accurately assess long-term oncological endpoints such as biochemical, salvage free, overall, or disease-specific survival. The authors concluded that the three-year follow-up demonstrated that MRI-guided TULSA has low morbidity and stable medium-term outcomes, without affecting QoL or limiting salvage therapeutic options. However, larger well designed clinical trials with increased ablation coverage are needed to assess the efficacy of MRI-guided TULSA. No health disparities were identified by the investigators.

Insufficient evidence exists in the published peer reviewed medical literature to permit conclusions on the role of this therapy in the treatment of prostate cancer.

Medicare Coverage Determinations

	Contractor	Determination Name/Number	Revision Effective Date
NCD	National	No National Coverage Determination found	
LCD	CGS Administrators, LLC	Magnetic Resonance Image Guided High Intensity Focused Ultrasound (MRGFUS) for Essential Tremor (L37790)	9/7/2023
LCD	National Government Services, Inc.	Magnetic Resonance Image Guided HIGH INTENSITY FOCUSED ULTRASOUND (MRgFUS) for Essential Tremor (L37421)	4/21/2022
LCD	Wisconsin Physicians Service Insurance Corporation	Category III Codes (L35490)	4/27/2023
LCD	Noridian Healthcare Solutions, LLC	Magnetic-Resonance-Guided Focused Ultrasound Surgery (MRgFUS) for Essential Tremor (L37729)	7/30/2023

	Contractor	Determination Name/Number	Revision Effective Date
LCD	Noridian Healthcare Solutions, LLC	Magnetic-Resonance-Guided Focused Ultrasound Surgery (MRgFUS) for Essential Tremor (L37738)	7/30/2023
LCD	First Coast Service Options, Inc.	Magnetic-Resonance-Guided Focused Ultrasound Surgery (MRgFUS) for Essential Tremor (L38506)	7/12/2020
LCD	Palmetto GBA	Magnetic Resonance Image Guided High Intensity Focused Ultrasound (Mrgfus) For Essential Tremor (L37761)	8/13/2020
LCD	Novitas Solutions, Inc.	Magnetic-Resonance-Guided Focused Ultrasound Surgery (MRgFUS) for Essential Tremor (L38495)	7/12/2020

Note: Please review the current Medicare Policy for the most up-to-date information.
(NCD = National Coverage Determination; LCD = Local Coverage Determination)

Coding Information

Notes:

1. This list of codes may not be all-inclusive since the American Medical Association (AMA) and Centers for Medicare & Medicaid Services (CMS) code updates may occur more frequently than policy updates.
2. Deleted codes and codes which are not effective at the time the service is rendered may not be eligible for reimbursement.

Considered Medically Necessary when used as a treatment for recurrent localized prostate cancer following the failure of radiation therapy when criteria are met:

CPT®* Codes	Description
55880	Ablation of malignant prostate tissue, transrectal, with high intensity-focused ultrasound (HIFU), including ultrasound guidance

Considered Medically Necessary when used for pain palliation in an individual with metastatic bone cancer who has failed or is not a candidate for radiotherapy when criteria are met:

HCPCS Codes	Description
C9734†	Focused ultrasound ablation/therapeutic intervention, other than uterine leiomyomata, with magnetic resonance (MR) guidance

†Note: Considered Experimental/Investigational/Unproven when used to report Magnetic resonance (MR)-guided transurethral ultrasound ablation (TULSA) for the treatment of prostate cancer.

Considered Medically Necessary when used for essential tremor (ET) that is refractory to medical therapy when criteria are met:

CPT®* Codes	Description
0398T	Magnetic resonance image guided high intensity focused ultrasound (MRgFUS), stereotactic ablation lesion, intracranial for movement disorder including stereotactic navigation and frame placement when performed

Considered Not Medically Necessary:

CPT®* Codes	Description
76999	Unlisted ultrasound procedure (eg, diagnostic, interventional)
0071T	Focused ultrasound ablation of uterine leiomyomata, including MR guidance; total leiomyomata volume less than 200 cc of tissue
0072T	Focused ultrasound ablation of uterine leiomyomata, including MR guidance; total leiomyomata volume greater or equal to 200 cc of tissue

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Revision Details

Type of Revision	Summary of Changes	Date
Annual Revision	• Revised policy statement for high-intensity focused ultrasound (HIFU) and magnetic resonance (MR)-guided focused ultrasound (MRgFUS) for other indications.	1/15/2024