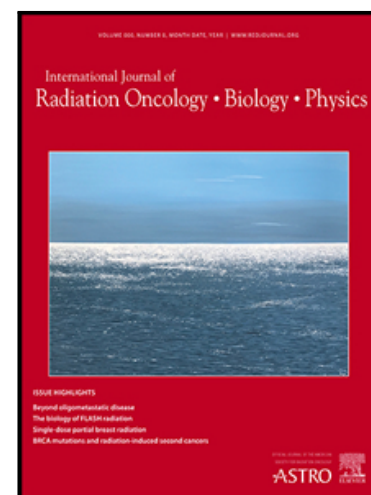


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# Three-dimensional treatment planning and target volume definition of tendinitis and bursitis - Consensus statement of the International Benign Target Volume Group (IBTVG)

**Short Title: LDRT in tendinitis and bursitis**

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## Abstract

Musculoskeletal disorders, particularly tendinitis and bursitis, are major contributors to global disability and healthcare burden. Low-dose radiotherapy (LDRT) has emerged as a promising treatment for refractory cases, demonstrating anti-inflammatory and anti-proliferative effects, especially in inflammatory conditions. However, the lack of standardized treatment volumes hampers reproducibility, radiation safety, and broader clinical adoption. To address this gap, an international panel of experts applied the Delphi method to develop consensus-based target volumes for LDRT in common indications such as shoulder bursitis, lateral elbow tendinitis, trochanteric pain syndrome, achilles tendinitis, and plantar fasciitis. Utilizing a standardized CT-based homunculus, target volumes were delineated in a 3D Cartesian coordinate system to enable precise definition of gross tumor volume (GTV), clinical target volume (CTV), and planning target volume (PTV). Additionally, associated ICD-10 codes were defined to facilitate clinical documentation, billing, and future research. This structured approach provides a foundation for consistent treatment protocols, improved radiation protection, and future prospective trials to refine LDRT application in benign musculoskeletal conditions.

## Introduction

Musculoskeletal conditions include not only a broad variety of different joints but also affect different tissues like muscles, bones and connective tissues such as ligaments and tendons. Worldwide, more than 1 billion people suffer from musculoskeletal conditions, making it the leading cause of years lived with disability worldwide, also resulting in significant healthcare costs and loss of productivity [1; 2]. Despite the availability of a wide range of treatment modalities ranging from pain medication, physical therapy, shock wave therapy, corticosteroid and other injections or even surgery in more advanced cases, a certain percentage of patients remain refractory to treatment [3; 4]. Even in patients with insufficient response to a respective plethora of treatment modalities, low-dose radiotherapy (LDRT) was able to achieve good therapeutic effects.

Further, LDRT for musculoskeletal conditions is a treatment modality that is gaining increasing interest in Europe and worldwide [5; 6]. While there is a large body of clinical evidence confirming the beneficial effects of LDRT, increasing understanding of the underlying molecular mechanisms is also highlighting the anti-inflammatory and anti-proliferative properties of this treatment, contradicting the notion of a solely placebo-driven effect [7; 8; 9]. While a large portion of data reporting the effects of LDRT in musculoskeletal conditions are from patients with osteoarthritis, data in inflammatory conditions such as tendinitis and bursitis show even better results compared to osteoarthritis [10]. Both tendinitis and bursitis are most often caused by overuse, degenerative changes and microtrauma leading to significant pain and loss of mobility and ultimately, loss of quality of life [11; 12]. Supplementary Figure 1 shows different inflammatory conditions on the example of the knee. Regarding the underlying pathological mechanisms, inflammation in tendinitis and bursitis affects multiple tissues and cell types. Although the exact pathological mechanisms are not fully understood, they often involve tendinosis, meaning degenerative changes rather than true inflammation, with microtears and scar tissue formation as well as abnormal collagen replacing normal tendon tissue [13]. Additional health conditions like diabetes, obesity and inflammatory conditions are well known to affect tendon health and are considered to be additional risk factors for tendinitis [14]. In the continuum model proposed by Cook and Purdam, tendinopathy progresses through overlapping pathological stages. The early reactive stage reflects a non-inflammatory proliferative response to mechanical overload, with tenocyte phenotypic changes and increased cellularity. This may advance to tendon disrepair, characterized by matrix degeneration and disorganized collagen synthesis, while tendon architecture and mechanical continuity remain partly preserved. Advanced degenerative tendinopathy involves largely irreversible structural damage, including cell death, marked matrix disorganization and loss of tendon integrity, often resulting in thickened and nodular tendons [15; 16]. Mechanistically, tendinopathy develops when matrix damage exceeds the tissue's reparative capacity. Repetitive microloading, frequently below the threshold of

clinically apparent injury, can drive progressive matrix degeneration. Tenocytes adopt an activated synthetic and remodeling phenotype, leading to aberrant collagen deposition and disruption of tendon architecture. Unlike osteoarthritis, chronic tendinopathy appears to be driven less by sustained inflammation than by maladaptive matrix remodeling [17; 18]. Against this background, LDRT represents a biologically plausible option for patients. Beyond its anti-inflammatory effects, LDRT can exert anti-proliferative and modulatory effects on activated stromal and connective-tissue cells, which may be relevant where tendon thickening and matrix disorganization are linked to increased tenocyte activity and aberrant extracellular matrix turnover [19].

In contrast, bursitis is an inflammatory disorder of the bursa. Bursae are synovial fluid-filled tissue sacs that reduce friction and act as a buffer against mechanical stress at points where bones come into contact with adjacent soft tissue, including muscles, tendons, ligaments, fascia and skin. By facilitating smooth gliding between these anatomical structures, bursae play an essential role in preserving physiological joint and periarticular movement. Although bursitis may occur at numerous sites throughout the body, the shoulder, elbow, hip and knee are among the most commonly affected regions. The condition is frequently precipitated by repetitive mechanical loading, sustained pressure over a joint, or acute trauma. Age-related changes may further increase susceptibility, as tendons and periarticular tissues progressively lose elasticity and become more vulnerable to injury. In addition, systemic conditions such as arthritis, diabetes mellitus and infection may contribute to the development or persistence of bursitis [20; 21; 22; 23].

The exact molecular mechanisms involved in irradiating bursitis and tendinitis syndromes using LDRT remain poorly understood [8; 12; 20]. Different radiation dosages or larger irradiation volumes may have to be considered, for example, due to less clearly defined anatomical boundaries compared to osteoarthritis or due to distinct biological responses resulting from a different underlying molecular pathophysiology in tendinitis [24; 25]. Tendinitis commonly affects areas such as the shoulder, biceps tendon, tendons of the elbow and the wrists, as well as the achilles tendon and tendons in the ankles. Tendovaginitis (tendon sheath inflammation) is a painful inflammation of the tendon sheaths, often caused by overuse or strain often affecting the wrist, fingers or feet (e.g. deQuervain's tendovaginitis). Bursitis, on the other hand, is an acute or chronic inflammation of the fluid-filled sacs that act as cushions between bones, tendons, muscles and skin near joints. Typical symptoms of all of these conditions include pain, swelling, increased temperature, restricted movement and loss of quality of life [26]. Both conditions mainly affect the shoulder, elbow, hip, knee and ankle. Due to a close anatomical relationship, progressive inflammation and common risk factors, bursitis and tendinitis often occur together and can even exacerbate each other [27; 28].

As summarized in Supplementary Table 1, the available clinical literature provides substantial evidence on the use of LDRT for tendinitis and bursitis, indicating favorable outcomes across a broad spectrum of conditions. The table compiles retrospective and prospective unicentric and multicentric studies, including information on treatment regimens, dose concepts, patient numbers, and reported clinical responses. Taken together, these data suggest that LDRT can meaningfully improve symptoms in various forms of tendinopathy and bursitis.

LDRT for tendinitis can be delivered using either LINAC-based techniques or orthovoltage therapy, with LINAC-based approaches currently used more frequently in many departments. However, clinical superiority of either modality has not yet been demonstrated. While LINAC-based planning may enable greater geometric precision, particularly when supported by MRI-based anatomical information, it is also more resource-intensive and may not be feasible in all clinical settings. Automated contouring, image-guided radiotherapy, and emerging MRI-only workflows may help standardize diagnosis, target definition, and treatment delivery, but require systematic evaluation before routine implementation. The standard treatment workflow for orthovoltage and LINAC-treatment is presented in Figure 1.

While LDRT has shown promising therapeutic benefits in the treatment of both bursitis and tendinitis, a clearly defined standard for its application in these conditions is lacking. Although the lower radiation doses used in LDRT suggest a reduced risk of acute toxicity, adherence to the ALARA (As Low As Reasonably Achievable) principle also necessitates a precise definition of treatment volumes especially considering potential systemic effects of LDRT [53]. This definition of treatment volumes ensures optimal therapeutic outcomes while minimizing unnecessary radiation exposure [54]. A well-defined description of the radiation volume is essential not only for establishing standardized treatment protocols but also for accurately assessing the potential risk to adjacent, non-target tissues. Standardized treatment guidelines provide a critical foundation for future prospective studies and are indispensable for evaluating the short- and long-term safety profiles of LDRT [55; 56; 57]. The use of 3D CT-based target volumes in clinical practice and prospective studies could improve interinstitutional comparability, support structured education, and provide a foundation for future expert-driven and international refinement of target volume concepts.

The objective of this paper is to present treatment volumes developed through the consensus of an international consortium of experts in the application of LDRT for benign conditions, the International Benign Target Volume Group (IBTVG). The IBTVG is composed of experts from 15 international institutions that were selected for their clinical expertise (i.e.  $\geq 2$  years' experience in LDRT and participation in peer-reviewed publications). The presented target treatment volumes include graphical representations, standardized nomenclature, and associated ICD-10 codes for the most commonly treated indications (see Supplementary Figure 2), namely bursitis and tendinitis of the upper and lower limb. By offering this structured framework, we aim to support the development of international consensus guidelines and facilitate collaboration in the generation of urgently needed prospective, high-quality and placebo-controlled, data.

## Methods

The German working group for benign diseases (established 1996) had previously generated organ-specific definitions; the most recent recommendations were incorporated into the 3rd revision of the national DEGRO guidelines, which have been available in an English version since 2024. The Delphi process was chosen to determine the consensus target volumes within the IBTVG framework, so that the recommended treatment volumes would be based on the expertise of an international panel. While there are no clear contouring guidelines for a particular approach to delineate radiation volumes, the Delphi process allows for structured feedback from all participating experts, potentially reducing the possible influence of more prominent individuals and has been successfully applied in other clinical contexts [58; 59]. For the generation of consensus target volumes fifteen institutions from the United States, Germany, the United Kingdom, Belgium, Spain, Italy, and Switzerland were selected based on:  $\geq 2$  years' clinical experience in practicing radiotherapy for nonmalignant conditions, relevant publications, and commitment to a structured consensus process. The selected expert panel consisted of a total of 21 experts (18 radiation oncologists and 3 medical physicists; 14 men and 7 women) from university hospitals, community hospitals, and multi-site outpatient practice networks, thus covering a broad spectrum of clinical practice and treatment experience. Participants attended a two-day hybrid seminar in Essen, Germany, organized by the group chair, covering anatomical orientation (Cartesian coordinate system), imaging and contouring principles, and standardized definitions of GTV, CTV, and PTV. Joint-specific and corresponding tendon/bursal anatomical definitions were provided. The two mandatory teaching sessions ensured methodological consistency prior to contouring. Gold-standard target volumes were developed using a standardized, three-dimensional CT reference dataset known as the 'homunculus', which covered the head, neck, thorax and upper and lower extremities. The homunculus was a standard CT scan of a male body recorded using a Siemens Somatom Scope, Siemens Healthineers, Erlangen, Germany, 2018.

Illustrative volumes were defined for various soft tissue disorders (e.g. tendons and bursae) and were used as reference material in subsequent consensus rounds. A total of three consensus rounds were carried out. While 18 participants initially attended the first consensus round, 12 (67%) attended the final round of the consensus process. Each participant completed the contours individually according to their experience and institutional protocol. A secure electronic platform hosted by the Department of

Radiation Oncology, University of Münster facilitated task allocation, contour submission, and structured feedback. All participants were instructed and guided to delineate their treatment volumes on the standardized CT dataset using individual login credentials to access and download the dataset from the centralized server hosted in Münster Germany. Standard radiotherapy planning CT protocols with adequate spatial resolution and soft-tissue contrast were used for target volume delineation. This purpose-built 3D anatomical reference model was chosen to ensure a uniform spatial framework and to allow reproducible comparison of contouring approaches across institutions.

Treatment volumes were generated for calcified bursitis of the shoulder, tendinitis of the biceps longus tendon, medial and lateral elbow tendinitis and deQuervain's tendinitis of the wrist, trochanteric bursitis, iliotibial band syndrome of the knee, patellar tendon syndrome of the knee, achilles tendinitis of the foot and plantar tendinitis of the foot. Further, participants were asked to present their contours for the tibialis anterior and posterior syndrome. All generated contours were uploaded back to the central server in Münster Germany. The consensus process was carried out in multiple iterative rounds of contour submission and structured group discussion, with the final agreement achieved through a collective expert review. Consensus was defined a priori as  $\geq 90\%$  agreement among the 18 participating experts on the final anatomic boundaries for each target structure; residual disagreements were resolved through structured group discussion in the final consensus meeting. Interobserver variability, consensus-derived target volume extensions in all three spatial planes at the isocenter level for the homunculus, including inter-institutional standard deviations are presented in Table 1.

### **The Cartesian Coordinate System XYZ**

The ability to locate or address any point in three-dimensional space is of great importance for the characterization of a volume or certain features for the generation of target volumes. The introduction of a coordinate system can therefore be used to accurately specify and describe target volumes in 3D space volumes. While there are several possible coordinate systems, the most obvious is the Cartesian system, as it is the same used in CT and MR imaging, which are essential imaging modalities in the development of LDRT. It is further used in multiple disciplines like engineering and computer science, potentially paving the way for more advanced treatment approaches [60]. As shown in Figure 2, the coordinate system uses the xyz-axis for 3D positioning. The x-axis (axial plane) describes a shift from medial (+) to lateral (-). The y-axis (coronal plane) is used to describe a shift from inferior (-) to superior (+). The z-axis (sagittal plane) describes different locations in the sagittal direction from dorsal (-) to ventral (+) [61]. To optimize the use of the coordinate system, a clear definition of positioning is required.

### **Target Volume**

The gross target volume (GTV, shown in orange) was defined for each target volume to include the area of inflammation and clinical pain. If available, clinical examination and an MRI scan should be used to aid GTV delineation. The clinical target volume (CTV, shown in pink) also included the subclinical volume. The CTV should encompass wider areas than the primary areas of inflammation, including the affected muscle, tendon and direct bone insertions. Depending on the location, the CTV should extend up to 2 cm beyond the insertion into the bone, up to 3 cm into the affected tendon or muscle. The PTV (planning target volume, red) is generated by expanding the CTV to account for patient movement and setup management to avoid under-dosing of inflamed areas, ultimately improving treatment accuracy and efficacy [62]. The expansion of the CTV to the PTV depends on departmental protocols, and the setup details, for instance the specific immobilization devices used. Further a 0.2 cm safety margin should be used to exclude the skin, when possible, to enable dose coverage of volumes and to avoid potential addition of unnecessary bolus. Expansion values of 0.2 to 1.5 cm were used to expand from CTV to PTV, depending on the respective anatomy and localization. A safety margin of 0.2 cm from the treatment volume to the skin was maintained whenever possible for treatment volume definition.

## Indications

The consensus result of the most common indications is presented here. Details about further localizations are collected in the supplementary material (Supplementary Figure 3 to 8). An overview of tendon isocenter locations as defined by expert consensus and CTV boundaries for tendinitis and bursitis is summarized in Table 2.

### *Subacromial bursitis of the shoulder (M75.5)*

While there are various possible locations for bursitis of the shoulder, subacromial bursitis of the shoulder was chosen as an example. In this case, there is an inflammation of the subacromial bursa, usually located under the acromion above the rotator cuff tendons. The rotator cuff tendons are made up of the *M. supraspinatus*, *M. infraspinatus*, *M. teres minor* and *M. subscapularis* tendons. Due to the narrow space between the acromion and the humeral head, inflammation of the bursa or the tendons causes discomfort and restriction of movement. In addition to the subacromial bursa, inflammation may potentially also occur in the subdeltoid, subscapular, infraspinatus and coracoid bursae [63; 64]. The example below depicts the treatment volume for the subacromial bursitis. An MRI scan should be considered for treatment delineation if available.

First, the isocenter should be located in the center of the subacromial space. The GTV should include the typical location of the subacromial bursa. The cranio-caudal limit should include the volume between the coracoid process and the upper part of the humerus. The CTV should not include the bone of the osseous structures. The lateral part of the CTV should extend to the medial part of the deltoid muscle. The medial border of the CTV does not need to extend to the *M. supraspinatus* origin in the supraspinatus fossa of the scapula. In the case of additional involvement of the supraspinatus tendon, an extension of the medial border of the CTV is possible, but should be decided on a case-by-case basis. Regarding the lateral border, in individuals with less developed muscle structures or adipose tissue, the extension value can be chosen smaller to respect the 0.2 cm safety margin to spare the skin, Figure 3. The extension of the PTV margin from the CTV should be approx. 0.5 medially and 0.8-1.2 cm laterally, as well as approx. 0.5-1.0 cm cranio-caudally and 0.5-1.0 cm ventro-dorsally, as depicted in Figure 3.

### *Lateral tendinitis of the elbow (M77.1)*

Lateral tendinitis/epicondylitis of the elbow, also known as tennis elbow, is most commonly caused by overuse of the extensor tendons on the lateral aspect of the forearm. It results from several muscles forming a common extensor tendon that originates from the lateral epicondyle. The primary muscles involved are the *M. extensor carpi radialis brevis* with secondary involvement of the *M. extensor carpi radialis longus*, *M. extensor digitorum*, *M. extensor carpi ulnaris* and *M. extensor digiti minimi* [65].

The isocenter should be located directly on the *epicondylus lateralis* of the humerus to ensure easy reproducibility. The tendons of the respective muscles form a common extensor tendon. The GTV should include the full extent of the common extensor tendon. The GTV should also partially include 0.5 cm of the humeral bone, as the extensor tendon extends into the bone for stability. The CTV should include an additional distal extension of 5-6 cm, following the course of the muscles. The CTV should proximally include a distance of 1.5-2.0 cm to ensure full inclusion of the extensor tendon. The proximal-distal ratio should be approximately 1:3 cm. Where MRI imaging is available, individual adjustment may be possible based on the extension inflammatory changes into the tendons. Due to the proximity of the *epicondylus lamina* to the skin, it is often not possible to achieve uniform expansion to create the PTV. The extension of the PTV margin from the CTV should be approx. 0.5 medially and 0.2-0.5 cm laterally as well as 0.8-1.2 cm cranio-caudally and 0.5-0.8 cm ventro-dorsally, as depicted in Figure 4. The standard safety margin of 0.2 cm to the skin should be maintained where possible, also see Figure 4.

### *Greater trochanteric pain syndrome (GTPS) (M70.6)*

This syndrome often results not only in localized pain over the lateral hip, particularly the greater trochanter, but can also lead to limitations such as gluteal weakness and sometimes even pain radiating down the lateral thigh or proximally towards the buttock. This condition involves inflammation or degeneration of the tendons, primarily the *gluteus medius* and *gluteus minimus* tendons, that attach to the greater trochanter of the femur, and possibly bursitis of the greater trochanter and other. In fact, bursitis is often secondary to tendon pathology rather than the primary cause. The deep gluteal muscles such as the *obturator internus*, the *piriformis*, and the *superior* and *inferior gemellus* may also contribute to the syndrome and should be included, at least in those anatomical portions close to the trochanter. Deep hip muscles in the medial compartment of the thigh, such as the *obturator externus* and *pectineus*, may also contribute to the syndrome and should be included in the irradiation volume [66]. The availability of an MRI scan can be a significant advantage in localizing the individual origin of the syndrome and may facilitate the tailored emphasis of specific anatomical areas based on individual patient presentation.

With regards to radiation volume, the isocenter should be located directly on the lateral apex of the greater trochanter. The CTV should be crescent-shaped around the greater trochanter. The cranio-caudal extension should extend 6-8 cm in both directions as visualized in the example below. The medio-lateral field extension should be approximately 4-6 cm in total. The antero-posterior extension of the field should be 4-6 cm. The extent of inclusion of the tendons must be adapted to the individual anatomy, but should include the ventral and dorsal insertions into the greater trochanter region. The medial extension of the radiation field should include a 1-2 cm section of bone. The femoral head should be excluded to avoid potential long-term side effects. The extension of the PTV margin from the CTV should be 0.5-0.8 cm medially and 0.2 cm laterally. The cranio-caudally extension should be approx. 0.8-1.2 cm and 0.2 cm ventro-dorsally as depicted in Figure 5.

### *Achilles tendinitis of the foot (M76.6)*

Achilles tendinopathy is a condition that affects the achilles tendon, the strongest tendon in the foot. Achillodynia can affect the insertion of the tendon and/or the entire extent of the tendon. While clinical examination is essential to locate the source of pain or inflammation, further MRI imaging can significantly enhance the precision of anatomical localization and inflammatory changes [67].

The isocenter should be located at the *tuber calcanei*. The CTV should include the tendon from the calcaneal tuberosity as well as achilles tendon proximally up to 6 cm. In cases of more proximal inflammation, it is advisable to extend the CTV more cranially. The CTV should include half of the dorsal calcaneus to account for the extensive insertion of the tendon into the calcaneus. While the dorsal extension of the CTV is limited by its proximity to the skin, the ventral border of the CTV can include anatomical structures adjacent to the *peroneus longus* and *brevis* tendons. The PTV volume is created by expanding the CTV by 0.8-1.2 cm in the cranio-caudal direction and 0.2-0.5 cm in the medio-lateral direction. Dorsal expansion is limited by proximity to the skin. Ventral extension is usually limited to 0.5 cm. While the following example shows a tendinitis of the insertion, Figure 6A, more proximal tendinitis will require a similar approach.

### *Plantar fasciitis of the foot (M72.2)*

Plantar fasciopathy is a condition of strain and inflammation of the plantar fascia, a thick band of fibrous tissue, causing pain in the plantar aspect of the heel. While the fascia extends from the heel to the toes, the inflammation usually originates from the point of insertion at the heel bone.

The isocenter should be at the apex of the calcaneal spur if present [68]. If there is no spur, then the isocenter should be positioned at the insertion point of the plantar fascia in the calcaneus. The GTV should include the plantar fascia at just over half of its full extent. Due to the proximity of the inflammation to the overlying musculature, it may be beneficial to include these in the CTV. It is not

advisable to include the entire dome of the foot in the CTV. The CTV must account for the splitting of the fascia anteriorly, which does not allow the CTV to narrow anteriorly. Due to potential bone edema, the CTV should also include the full dorsal extension of the heel bone. The PTV requires an extension of the CTV of 0.8-1.2 cm in the cranio-caudal direction and 0.5 cm in the ventro-dorsal direction. The dorsal extension may be as little as 0.5 cm to avoid extension beyond the skin. The medio-lateral margin should be extended by 0.5-1.0 cm, as seen in Figure 6B.

#### **Diameter of the target volumes for various tendinitis/bursitis regions along the three axes (x, y, z) within the isocenter plane.**

The sample standard deviation for the 15 participating institutions was calculated and is given in square brackets (cm). The diameter per axis was calculated as the sum of the positive and negative excursions (e.g. X-plus + X-minus from the isocenter). Varying sample sizes are due to missing entries from individual institutions, see Table 1, the consensus results in written form is presented in Table 2.

## **Discussion**

The treatment of musculoskeletal disorders represents one of the most significant healthcare challenges of the coming decades, especially regarding the anticipated increasing number of affected individuals in an aging population [1]. While a range of treatment options are available, a growing number of older patients are hesitant to undergo invasive procedures due to associated risks, fear of decreased quality of life, and the often time-consuming and burdensome rehabilitation process [69]. LDRT has long been employed successfully especially in Central and parts of Eastern Europe. The convincing results have led to an increase in treatment numbers over time [9]. While there is a large number of publications reporting good treatment results (as summarized in [12]), two smaller prospective, placebo-controlled data have failed to show a statistically significant benefit of LDRT treatment [70; 71]. However, these studies show significant methodological deficits. A review of available data delineates a clear framework for the proper administration of the treatment [72]. Nonetheless, the absence of universally accepted standards leads to substantial variability in radiation dose regimes, treatment frequencies as well as treatment volumes [12], Table 3 shows an overview of all studies that included target volumes in the use of LDRT.

Although LDRT has shown promising results, mainly in retrospective studies, there is a significant requirement for evidence from randomized controlled trials, particularly for tendinopathies. Prospective studies such as those by Mahler and Minten et al. have failed to demonstrate a clear benefit in the case of osteoarthritis, although the limitations of these trials have been discussed in the literature [72]. Even less evidence from prospective sham-irradiation studies is available for tendinopathies. Nevertheless, the randomized dose-finding study by Ott et al. on elbow tendinopathy (3 Gy vs. 6 Gy) reported a significant and sustained clinical effect. Further studies by Niewald et al. [45] and Canyilmaz et al. [73], which investigated LDRT for plantar fasciitis, demonstrated a significant and durable clinical benefit, even though they were not randomized against sham irradiation. Despite the convincing clinical data, standardized anatomical target volume definitions are needed to enable reproducible treatment delivery and improved comparability between centers, as well as to support the design of future prospective trials. The required prospective validation could include studies comparing guideline-based standardized volumes with individually contoured approaches.

Despite an extensive, two-day teaching session covering anatomical sites and diseases prior to the individual contouring process, deviations in the target volume contours were evident at an institutional level, depending on the specific localization and respective body axis. Standard deviations were particularly high along the y-axis. This is primarily because extending along tendons, both proximally and distally, is often difficult to define and requires intensive clinical examination and/or magnetic resonance (MR) imaging. As neither of these were available for this project, greater deviations occurred, largely depending on pre-existing clinical experience. Nevertheless, our results showed

greater deviations for larger structures, such as the patellar tendon or the knee region, than for smaller structures, such as the extensor tendon in the elbow region. The relatively large deviations observed in diagnosis may be due to a lack of knowledge about treating certain conditions, such as de Quervain's wrist syndrome. This may be because the respective radiotherapy treatment is less common due to a lower incidence, as well as an overall lack of therapeutic knowledge regarding the use of LDRT for this condition. Although the present contouring was applied to a healthy standard CT homunculus without the option of clinical examination or further pathological imaging such as an MRI scan, the high deviations could probably be significantly reduced if the standardized target volumes, clinical examination and imaging were available.

In addition to the absence of standardized treatment protocols, there is also a lack of a clearly defined coordinate system or a comprehensive nomenclature which hampers effective teaching, technological implementations and further scientific developments [74]. A defined and standardized coordinate system is valuable for precisely defining the required treatment in three dimensions. Among the various possible axis orientations, the orientation described in CT and MRI imaging was chosen to pave the way for further technical approaches and enable further analysis using automated, AI-based, rendering contouring methods. The introduction of a coordinate system has the great advantage of allowing exact localizations in a 3D volume. It also makes it possible to accurately describe changes in treatment volumes over time, as demonstrated in ongoing studies. Furthermore, it can improve teaching by providing scalable references for distances and directions from defined anatomical landmarks [75].

As described above, the use of ICD-10 diagnostic codes is essential for standardization and billing, and for the accurate documentation of different indications. They are much more precise than generic terms such as "shoulder syndrome". Thus their application can also improve patient care by supporting clinical decision-making, facilitating research, and improving the monitoring of disease patterns and treatment outcomes [76]. From a public health perspective, it enables disease statistics to be tracked and helps to identify local, national and global trends. In emerging fields such as data analytics, coding plays an important role in data collection and analysis for clinical research and epidemiology, and can inform evidence-based policymaking. It can also be used for quality assurance, such as healthcare quality assessment, audits and benchmarking, by providing structured diagnostic information [77].

Although a substantial body of evidence supports the clinical efficacy of orthovoltage therapy, the lack of imaging guidance always carries the risk that the treatment volume may be unnecessarily large or fail to match the patient's individual anatomy. Despite detailed specifications regarding tube and field sizes, the application of radiation involves a degree of spatial uncertainty. The lack of precise treatment volume definition is a major disadvantage in terms of radiation protection, underscoring the need for clear documentation of the doses allocated to each individual site. Although no long-term side effects or secondary malignancies in LDRT patients have been observed to date, other studies report potential risks even in low-dose areas that warrant thorough investigation and minimization where possible [78; 79; 80].

Although the Delphi method was chosen as the evaluation method, it carries both advantages and limitations. While it is widely considered an objective tool for achieving expert consensus, there is a potential imbalance in expertise, as countries with more than 40 years' experience may be underrepresented due to more diverse decision-making processes. Nevertheless, we believe that including an international consortium of experts would be beneficial for disseminating new knowledge and adapting to new scientific findings on an international scale, where different opinions and insights can be shared. Another limitation of the Delphi method is the potential for expert bias [81]. This is somewhat mitigated due to the relatively small number of international experts. Additionally, although the multi-round nature of the Delphi process can be time-consuming and may lead to participant fatigue, engagement in this study remained high, and participation was productive overall [82]. As each expert was responsible for providing their own contours, there was no over-reliance on group consensus, which

could have resulted in a lack of individual accountability. This study demonstrates the feasibility of creating consensus guidelines on target volumes for LDRT in cases of tendinitis at various anatomical sites. As seen in Supplementary Table S1, depending on indication, there were partially high deviations in treatment volumes, stressing the need for standardized treatment volumes in benign diseases. To our knowledge, this is the first attempt to produce expert guidelines involving specialists from different institutions and countries. The guidelines lay the foundation for potential future international treatment harmonization, and could serve as a cornerstone for further standardization, as well as for the initiation of multinational prospective studies and further basic and comparative research in this field. Another limitation of the present work is that the delineation of GTV as well as the expansion of the CTV are based mainly on expert opinion and clinical experience rather than objective data. The implementation of MRI imaging could aid a more individualized and anatomically precise treatment volume definition [83]. Further standardization efforts could also address other critical aspects of treatment planning like the optimal number of fractions, and total treatment duration as well as total and single dose.

Another benefit of standardized target volumes in LDRT is that they allow the radiation field's exact location, size and shape to be defined precisely. Well-defined radiation fields are valuable radiation protection tools that help to avoid unnecessary exposure of surrounding tissues and organs at risk (OARs) to radiation. They also greatly improve planning consistency, standardize treatment and facilitate clear communication and verification of treatment protocols. Using a common contouring guideline allows for adaptability in response to current or emerging scientific evidence. Ultimately, higher levels of precision increase the likelihood of overall treatment success.

The presented target volume contours are intended to provide educational advice for future treatments and guidance for prospective clinical studies. However, these anatomically specific contours will need to be adapted to the anatomy and clinical presentation of each patient. Although clinical examination remains essential for defining the target volume, the increasing availability of MRI could complement 3D CT-based planning in this respect. This is particularly true of additional T2-weighted, proton density and fat-saturated sequences, which improve visualization of bony involvement and inflammatory extension into adjacent muscles. Although there are existing MRI guidelines for musculoskeletal disorders, there is currently a lack of evidence-based recommendations for the optimal MRI sequences to be used for target volume definition in low-dose radiotherapy. This issue should be addressed in future studies. Further clinical validation of the proposed treatment volumes is required.

This consensus statement is not intended to establish a mandatory clinical standard or imply that three-dimensional target-volume delineation is the proven standard for LDRT in tendinitis. The purpose of this statement is to improve reproducibility by providing anatomical and pathology-oriented frameworks for radiation field design. These frameworks are intended as a potential prerequisite for validation and as a starting point for harmonized prospective studies, rather than as an end goal. The current evidence base is heterogeneous and influenced by multiple factors, including patient selection, symptom duration, outcome assessment, single and cumulative radiotherapy dose, fractionation, and the number and intervals between treatment series. Accordingly, the proposed volumes are intended to improve comparability across studies and clinical settings, while remaining subject to refinement as new evidence emerges. It is important to note that these recommendations do not imply that the contours must be applied to every patient, particularly in settings with limited resources. Instead, they offer anatomical and pathological guidance that can be adapted to individual anatomy and disease patterns. This helps to avoid the unnecessary irradiation of unaffected tissue, in line with the ALARA principle. Overall, the development of consensus guidelines by an international panel of experts not only allows for a high-quality level of LDRT, but also provides the basis for further studies and the establishment of more refined standardized treatment protocols. While the definition of treatment volumes is of paramount importance, key parameters—such as radiation dose, fractionation schedule, overall treatment duration, and the choice between orthovoltage and linear accelerator (LINAC)-based modalities—remain insufficiently explored, as existing data often do not comprehensively address these factors.

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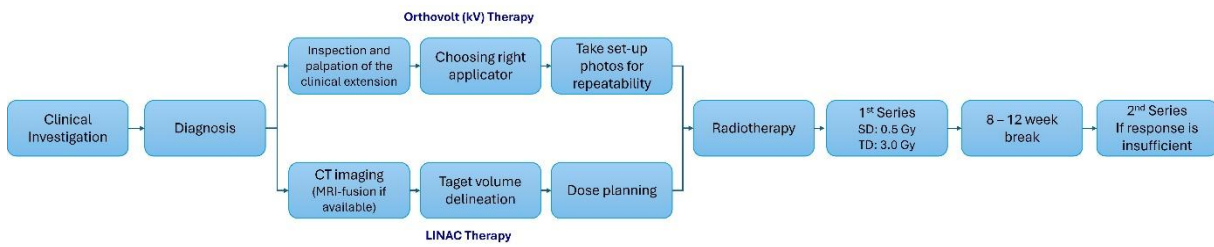
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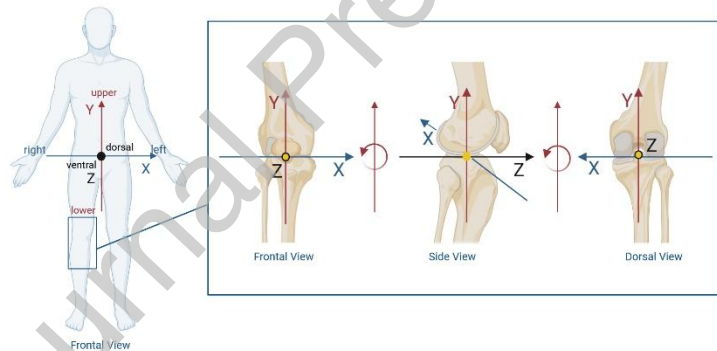
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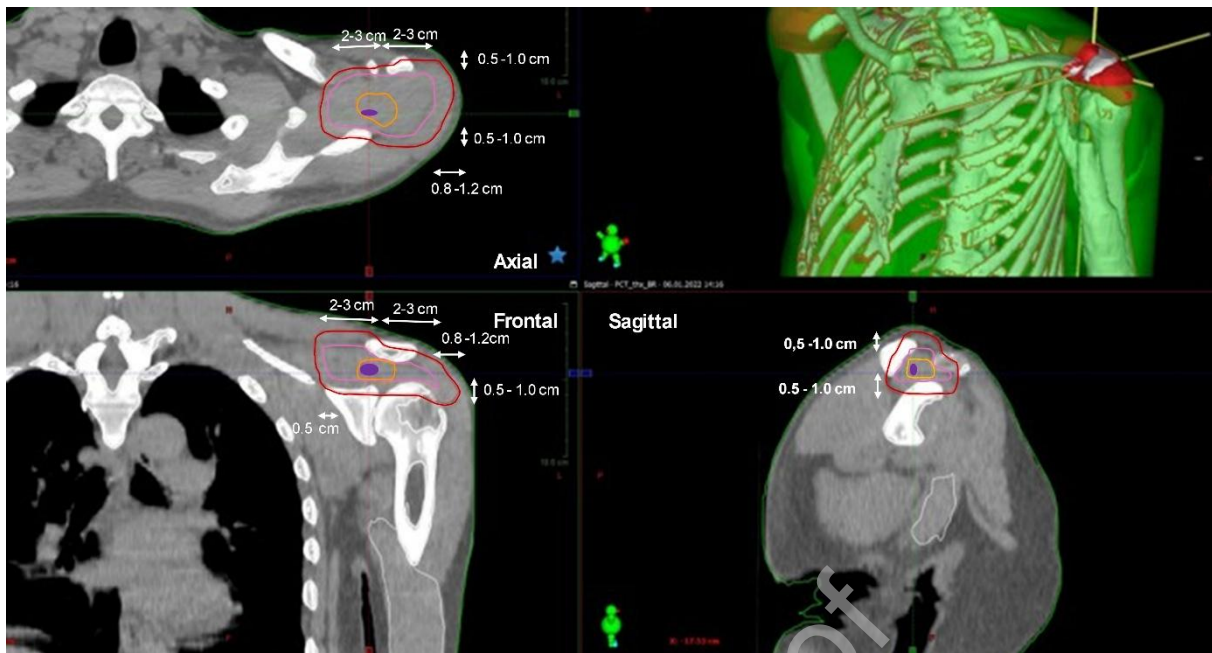
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**Figure Legends:****Figure 1: Treatment workflow for low-dose radiotherapy in tendinitis.**

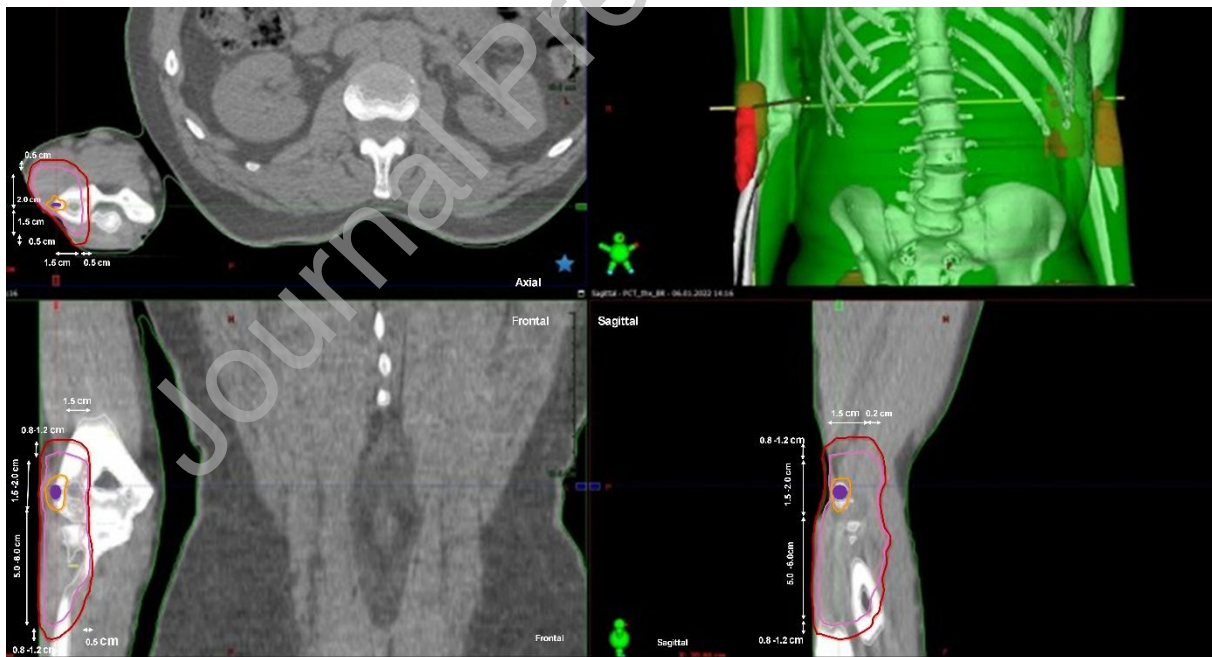
Schematic overview of the standard clinical workflow for LDRT in tendinitis using either orthovoltage therapy or LINAC-based treatment. After clinical investigation and diagnosis, orthovoltage treatment is typically based on clinical inspection and palpation of the symptomatic extension, selection of an appropriate applicator, and documentation of the set-up to ensure reproducibility. In LINAC-based workflows, CT imaging, with MRI fusion when available, is used for target volume delineation and dose planning. Treatment is commonly delivered as a first series of 0.5 Gy per fraction to a total dose of 3.0 Gy, followed by an 8–10-week break. A second treatment series may be considered in patients with insufficient clinical response.

**Figure 2: The orientation of the x- y- and z- axis presented are aligned according to the axis orientation in CT and MRI imaging to facilitate the transferability of information and communication.**

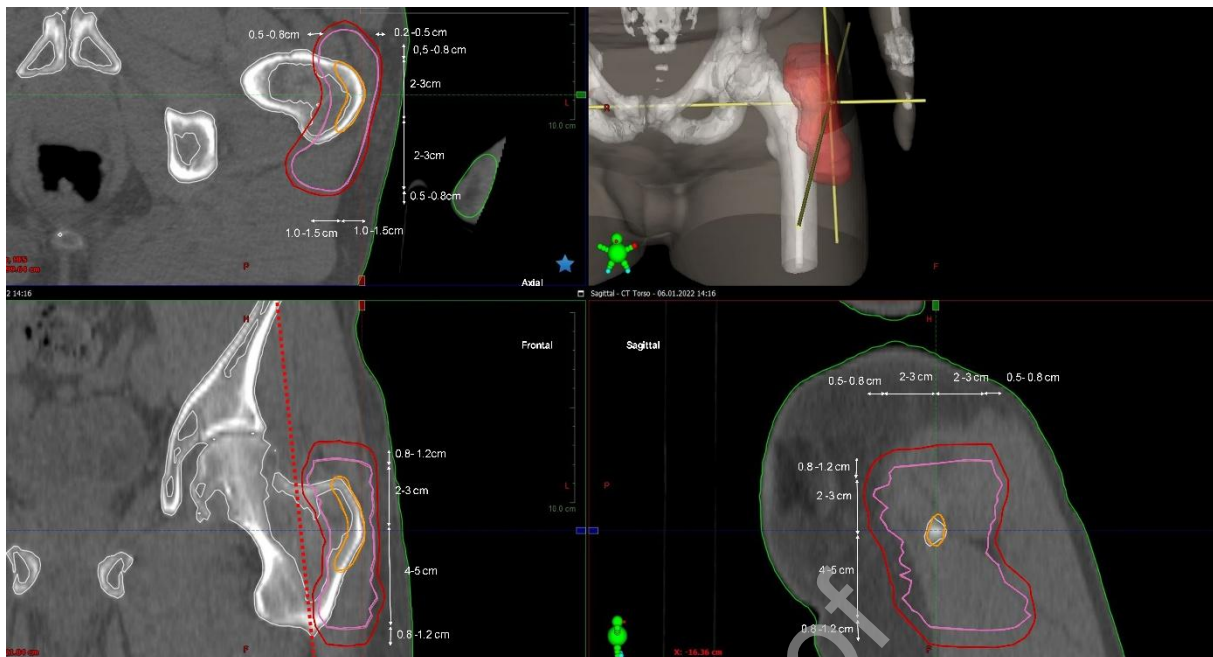
Created in BioRender. xxxxxxxx



**Figure 3: Subacromial bursitis of the left shoulder.** The irradiation volume should include the space between the acromion and the apical part of the humerus. While the lateral border is limited by the deltoid muscle, the medial extension does not need to include the *M. supraspinatus* to full extent. GTV is shown in orange, CTV in pink and PTV in red.



**Figure 4: Lateral tendinitis of the elbow:** The irradiation volume should include the insertion of the extensor muscles inserting at the *epicondylus lateralis*. The volume should include a safety margin proximally along the humerus but also extending distal along the course of the muscles. The medial border of the volume is a straight line through the olecranon. GTV is shown in orange, CTV in pink and PTV in red.



**Figure 5: Greater trochanteric pain syndrome, GTPS, of the left hip.** The treatment volume extents in a crescent shape around the *trochanter major*. Due to the fan-shaped insertion of the tendons into the bone, a sufficient amount of the bone should be also included in the volume. GTV is shown in orange, CTV in pink and PTV in red. The red dotted line represents the recess of the radiation field towards the femoral head.



**Figure 6: A: Achilles tendinopathy of the left foot:** Treatment volume includes the achilles tendon including half of the calcaneus. While the proximal extension of the field can be individually extended, the proximal extension should include at least a length of approximately 6cm. **B: Plantar fasciitis of the left foot.** The treatment volume includes the full calcaneus while reaching ventrally up to the middle of the dome of the foot. GTV is shown in orange, CTV in pink and PTV in red.

**Table 1: Results of the Delphi-process: Diameter of the target volumes for various tendinitis/bursitis regions along the three axes (x, y, z) within the isocenter plane.**

Results of the Delphi process are presented as mean  $\pm$  SD.: Overall, pronounced inter-institutional variability was observed, particularly along the coronal (y) axis, where the largest spread occurred for Achilles tendinopathy (foot – Achilles tendinopathy) (SD = 8.73 cm). The greatest deviation along the axial (X) and sagittal (Z) axes was found for knee ITBS (SD<sub>x</sub> = 4.39 cm; SD<sub>z</sub> = 4.65 cm). In contrast, smaller or more clearly delineated regions tended to show lower variability: elbow/lateral tendinitis along the X-axis (SD = 1.79 cm), foot/plantar fasciitis along the Y-axis (SD = 1.23 cm) and shoulder bursitis along the Z-axis (SD = 1.03 cm). Differences indicate a greater need for harmonization for complex or large target volumes. Reference images and structured training could improve the consistency of field definition. Standard deviations are given in brackets.

| Target volume diameter resulting from the Delphi process in cm along the axes in the isocenter plane with [standard deviations due to inter-institutional variability] |                      |                                      |                                 |                                |                     |                                    |                                          |                               |                            |                        |                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------------------------------|---------------------------------|--------------------------------|---------------------|------------------------------------|------------------------------------------|-------------------------------|----------------------------|------------------------|------------------------------|
|                                                                                                                                                                        | Subacromial bursitis | Tendinitis of the long biceps tendon | Lateral tendinitis of the elbow | Medial tendinitis of the elbow | Wrist De Quervain's | Greater trochanteric pain syndrome | Tendinitis of the iliotibial band (ITBS) | Patella tendon syndrome (PTS) | Foot Achilles tendinopathy | Foot Plantar fasciitis | Tendinitis tibialis anterior |
| Axial field size (x-axis)                                                                                                                                              | 4.3<br>[2.96]        | 4.3<br>[3.65]                        | 3.1<br>[1.79]                   | 3.2<br>[2.65]                  | 4.5<br>[3.35]       | 3.6<br>[2.52]                      | 5.1<br>[4.39]                            | 4.5<br>[2.41]                 | 3.7<br>[2.79]              | 4.9<br>[3.16]          | 3.6<br>[2.46]                |
| Coronal field size (y-axis)                                                                                                                                            | 5.1<br>[3.29]        | 7.0<br>[6.06]                        | 8.1<br>[4.77]                   | 6.7<br>[4.07]                  | 6.8<br>[4.07]       | 8.6<br>[3.56]                      | 11.3<br>[6.31]                           | 9.7<br>[6.69]                 | 11.4<br>[8.73]             | 4.1<br>[1.23]          | 12.1<br>[6.75]               |
| Sagittal field size (z-axis)                                                                                                                                           | 4.8<br>[1.03]        | 4.2<br>[1.96]                        | 3.6<br>[2.26]                   | 3.5<br>[2.01]                  | 3.7<br>[2.03]       | 5.3<br>[2.36]                      | 6.3<br>[4.65]                            | 4.1<br>[1.62]                 | 3.9<br>[3.19]              | 9.9<br>[4.06]          | 2.1<br>[1.15]                |

**Table 2:** Summary of the consensus-based recommendations for CTV boundaries for tendinitis and bursitis target volume delineation

| Tendinitis/bursitis (ICD-10 code)                                                                                     | Recommended Isocenter (reference point)                                         | Superior border                                                                                                                    | Inferior border                                                                                   | Anterior border                                                                | Posterior border                                                                                                     | Medial border                                                                                                                          | Lateral border                                                                    | Additional notes                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| <b>Subacromial bursitis (M75.5)</b>                                                                                   | Center of the subacromial space                                                 | Bursa as anatomical landmark; Acromion (inclusion of full osseous circumference)                                                   | Bursa as anatomical landmark; inferior border approx. 2cm around the inflamed bursa               | Bursa as anatomical landmark; should not extend beyond the coracoid process    | Bursa as anatomical landmark; should not extend beyond anterior border of the scapula                                | Bursa as anatomical landmark; inclusion of lateral half of the supraspinatus muscle.                                                   | Bursa as anatomical landmark; inclusion of the medial half of the deltoid muscle  | GTV: complete inflamed bursa<br>CTV: additional 2cm around the bursa; if needed with additional bone and muscle inclusion |
| <b>Tendinitis of the long biceps muscle (M75.2)</b>                                                                   | Superior scapular margin of the glenoid cavity ( <i>superglenoid tubercle</i> ) | Up to the roof of the acromion                                                                                                     | 2-3 cm into the muscle belly of the biceps brachii longus                                         | Limited by the skin with an appropriate skin-sparing margin                    | Inclusion of the intertubercular sulcus/bicipital groove of the humerus with additional 1-2 cm into the humoral bone | Upper edge of the glenoidhumeral cavity including approx. 2 cm of the scapula bone, additional 2 cm into the head of the humoral bone. | Medial margin of the deltoid muscle                                               | CTV should include the anterior half to anterior third of the humoral bone to account for possible osseous involvement    |
| <b>Medial elbow tendinitis (M77.0)</b>                                                                                | Medial epicondyle of the humerus                                                | Approx. 3cm proximal to the medial epicondyle                                                                                      | Approx. 6-8 cm distal into the tendon of the <i>extensor carpi</i> and <i>digiti</i> muscle group | Approx. 2-3 cm into the ventral muscle compartment                             | Approx. 2-3 cm dorsally into the dorsal muscle compartment                                                           | Limited by the skin due to the superficial course of the tendon                                                                        | Proximal: medial half of the elbow joint Distal: lateral margin of the ulnar bone | CTV extension proximal and distal to the insertion point should follow an approximate 1:2-3 ratio                         |
| <b>Lateral elbow tendinitis (M77.1)</b>                                                                               | Lateral epicondyle of the humerus                                               | Approx. 3cm proximal to the lateral epicondyle                                                                                     | Approx. 6-8 cm distal into the tendon of the <i>extensor carpi</i> and <i>digiti</i> muscle group | Approx. 2-3 cm into the ventral muscle compartment                             | Approx. 2-3 cm dorsally into the dorsal muscle compartment                                                           | Proximal: lateral half of the elbow joint Distal: medial margin of the radial bone                                                     | Limited by the skin due to the superficial course of the tendon                   | CTV extension proximal and distal to the insertion point should follow an approximate 1:2-3 ratio                         |
| <b>Tendovaginitis stenosis of Quervain (tendosheath vaginitis of the Musculus abductor longus and brevis) (M65.4)</b> | Lateral/Radial insertion base of the first metacarpal bone                      | Proximal extent may reach the distal forearm up to approx. 5-6 cm, depending on the individual insertion into the muscle bundle of | Distal border should include the proximal third of the <i>os metacarpale I</i>                    | Should include 1-2 cm into adjacent bone and soft tissues, e.g. flexor muscles | Limited by skin, with skin sparing where possible                                                                    | CTV should include the full medial extent of the trapezoidium bone and the base of the first metacarpal bone                           | Limited by skin, with skin sparing where possible                                 | Because the tendinitis may extend proximally, MRI and detailed individual clinical examination are recommended            |

|                                                          |                                                                            |                                                                       |                                                                                                    |                                                                                                          |                                                                                 |                                                                    |                                                                                                              |                                                                                                                        |
|----------------------------------------------------------|----------------------------------------------------------------------------|-----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
|                                                          |                                                                            | the <i>m. extensor pollicis longus</i>                                |                                                                                                    |                                                                                                          |                                                                                 |                                                                    |                                                                                                              |                                                                                                                        |
| <b>Greater trochanteric pain syndrome (M70.6)</b>        | Upper border of the greater trochanter                                     | 2-3cm superior above the muscles entering the greater trochanter      | Caudal border of the of the lesser trochanter                                                      | Approx. 2-3 cm anterior to the isocenter (exclusion flexor muscle group)                                 | Approx. 2-3 cm posterior to the isocenter (exclusion of extension muscle group) | Femoral head should be spared                                      | Including complete muscle group until subcutaneous fat layer                                                 | Avoid femoral head due to possible bone marrow islets; in case of MRI inclusion of 2-3 cm around the inflammation zone |
| <b>Tendinitis of the lateral iliotibial band (M76.3)</b> | Lateral border of the tibio-femoral joint                                  | The proximal border should extend 2-3 cm proximally to the pain zone. | 2-3 cm into the insertion into the tibial bone                                                     | Approx. 1-2 cm anterior to the iliotibial band                                                           | Approx. 1-2 cm dorsally to the iliotibial band                                  | 1-2 cm of the tibial and the fibular bone                          | Limited by the skin, with skin sparing especially ventrally                                                  | Craniocaudal extension should be individualized according to clinical tenderness and MRI-defined extent.               |
| <b>Tendinitis of the patella tendon (M76.5)</b>          | Inferior border of the patellar bone                                       | Superior border should go through half of the patella                 | Inferior border should include full extent of the insertion + 1-2 margin into the tibial bone      | Limited by skin, with skin sparing if possible                                                           | Approx. 2 cm posteriorly to account for rotation movement during treatment      | Approx. 1-2 cm medially to account for rotation during irradiation | Approx. 1-2 cm laterally. Due to high mobility in the hip reproducible immobilization of the knee is advised | CTV should be especially generous around the tibial insertion to account for possible osseous affection                |
| <b>Tendinitis of the anterior tibial muscle (M76.8)</b>  | Talofibular joint line (upper/lower border according to clinical findings) | Distal half of the lower leg                                          | Additional approx. 2 cm to the insertion point of the medial cuneiform and <i>Os metatarsale I</i> | Limited by the skin, with skin sparing especially ventrally                                              | Should extend into the anterior flexor loge                                     | Medial margin should extend to the midline of the tibia.           | Lateral margin should extend to the midline of the fibula                                                    | Intensive clinical examination and MRI imaging is advised to cover full extent                                         |
| <b>Achilles tendinitis of the dorsal heel (M76.6)</b>    | Center of the Achilles tendon                                              | Achilles tendon up to approx. 6 cm proximally                         | Calcaneal tuberosity including the dorsal half of the calcaneus                                    | Partial inclusion of the peroneus longus and brevis muscles not including the dorsal margin of the tibia | Limited dorsally by the skin                                                    | Medial margin of the subcutaneous skin layer                       | Lateral margin of the subcutaneous skin layer                                                                | CTV needs to be adapted to clinical examination findings and MRI extent                                                |
| <b>Plantar fasciitis of the foot (M72.2)</b>             | Anterior margin of the plantar calcaneus                                   | Lower border of the midfoot bones                                     | Lower border of the plantar muscle                                                                 | Plantar muscle group until tarsometatarsal                                                               | Full dorsal extension of the calcaneus bone                                     | Medial border of the calcaneal bone                                | Lateral border of the calcaneal bone                                                                         | CTV should include the proximal part of the                                                                            |

|  |  |  |                            |              |       |  |  |  |                                                                                                     |
|--|--|--|----------------------------|--------------|-------|--|--|--|-----------------------------------------------------------------------------------------------------|
|  |  |  | group<br>excluding<br>skin | rsal<br>line | joint |  |  |  | plantar<br>fascia and<br>the<br>respective<br>muscle<br>group<br>inserting<br>into the<br>calcaneus |
|--|--|--|----------------------------|--------------|-------|--|--|--|-----------------------------------------------------------------------------------------------------|

Journal Pre-proof

**Table 3. Overview of studies addressing target volumes and definitions for bursitis and tendinitis**

| Authors/Group, Title, Journal                                                                                                                                                                                                           | Inclusion of target volume (principle)                                                                                                                                                                                                               | Critical assessment                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Alvarez and Montero et al. Radiotherapy CT-based contouring atlas for non-malignant skeletal and soft tissue disorders: A practical proposal from Spanish experience. Br J Radiol 2021                                                  | <ul style="list-style-type: none"> <li>CT-based Contouring atlas for benign conditions focusing on anatomical bone landmarks and osteoarticular regions for definition of target volumes.</li> <li>PTV delineation guided by bony anatomy</li> </ul> | <ul style="list-style-type: none"> <li>Lack of defined GTV and CTV</li> <li>overly simplified definition of target volumes: not accounting for interindividual variability in bone morphology and joint height</li> <li>extensive treatment fields (Shoulder)</li> <li>no clear distinction to osteoarthritis</li> <li>lack of tendon aligned volume delineation</li> </ul> |
| German Cooperative Group on Radiotherapy for Benign Diseases (GCG-BD) Specialist group-specific evidence-based S2e guideline of the German Society for Radiooncology (DEGRO) Version 3.0 from Nov 19th 2022. DEGRO Guideline 2022 v 3.0 | <ul style="list-style-type: none"> <li>Illustrations &amp; explanations of practical recommendations (Section 4.1)</li> <li>Clinical field verification &amp; 3D planning with PTV definition based on imaging data</li> </ul>                       | <ul style="list-style-type: none"> <li>lack of tendon specific volume definitions</li> <li>Lack of defined GTV and CTV</li> <li>no clear definition of a 3D target volume planning</li> </ul>                                                                                                                                                                               |
| Seegenschmiedt et al. Radiotherapy for Non-Malignant Disorders: Contemporary Concepts and Clinical Results. Book, Springer New York, 2008                                                                                               | <ul style="list-style-type: none"> <li>Atlas and reference guide for the radiotherapy of benign conditions</li> <li>Numerous imaging examples of tendinitis cases, some including treatment fields (PTVs)</li> </ul>                                 | <ul style="list-style-type: none"> <li>Lack of explanation on target volume delineation; no clear description of PTV definition</li> <li>No specific focus on tendinitis</li> </ul>                                                                                                                                                                                         |
| Woodley et al. Morphology of the bursae associated with the greater trochanter of the femur. J Bone Joint Surg Am 2008                                                                                                                  | <ul style="list-style-type: none"> <li>Suggested craniocaudal PTV extension of 7 cm for the treatment of bursitis</li> </ul>                                                                                                                         | <ul style="list-style-type: none"> <li>PTV is too large and does not include the important soft tissues</li> </ul>                                                                                                                                                                                                                                                          |
| Hermann et al. Effect of field size and length of plantar spur on treatment outcome in radiation therapy of plantar fasciitis: the bigger the better? Int J Radiat Oncol Biol Phys 2013                                                 | <ul style="list-style-type: none"> <li>Target volume suggestions for calcaneodynia</li> <li>Smaller field sizes had the same positive treatment effect as large field sizes</li> </ul>                                                               | <ul style="list-style-type: none"> <li>No further explanation of field size definitions, e.g., whether based on radiological imaging such as X-rays</li> <li>Large fields were defined by including the entire calcaneal bone</li> </ul>                                                                                                                                    |