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Research Advances in Traditional Chinese Medicine Prevention and Treatment of Recurrence Following Osteochondroma Surgery

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Abstract:

Osteochondroma is prone to recurrence following surgical intervention, and modern medical treatments have inherent limitations. Traditional Chinese Medicine (TCM) possesses a theoretical foundation for the prevention and treatment of bone tumours. This study focuses on TCM approaches to preventing and treating post-operative recurrence of osteochondroma. Employing a methodology combining literature review with clinical case analysis, it examines clinical cases of patients who underwent osteochondroma surgery and relevant literature. Results indicate that TCM, centred on "tonifying the liver and kidneys," employs formulas such as Liuwei Dihuang Wan to promote bone repair and reduce recurrence rates. However, challenges remain in the standardization of TCM pattern differentiation. Conclusions suggest TCM can complement medical treatments, highlighting the need for in-depth research and standardised clinical application.

Keywords: Osteochondroma postoperative recurrence, TCM prevention and treatment, Tonify liver and kidneys, Syndrome differentiation treatment, Integrated Chinese-Western medicine

1. Introduction

Osteochondroma, a common benign bone tumour in children, Its postoperative recurrence rate is high, mainly attributed to residual tumor tissue and genetic factors. Modern medicine primarily relies on surgical intervention, it struggles to address recurrence and delayed bone repair. Traditional Chinese medicine (TCM) recognizes the pathogenesis of bone tumours as "kidney deficiency with phlegm-stasis" and possesses foundational application experience. However, standardized protocols and high-level evidence-based support are lacking, leaving significant research gaps. This paper explores advances in TCM prevention and treatment of post-operative osteochondroma recurrence. It investigates the efficacy of the core TCM therapeutic principle "tonifying the liver and

kidneys" in postoperative settings, analysing existing challenges regarding the therapeutic effects, clinical advantages, and syndrome differentiation standardisation of relevant core formulas. The study combines literature review with clinical case analysis and comparative research. Its significance lies in providing direction for post-operative TCM application, suggesting in-depth mechanism research and standardized protocol development to advance integrated Chinese-Western medical treatment. This will enhance efficacy and reducing recurrence rates.

2. Overview of Osteochondroma

Osteochondroma is a common benign bone tumour in childhood, typically originating from the cortical bone at the metaphysis and growing towards the bone surface, also referred to as exostosis. It may present as a solitary lesion or multiple lesions. Multiple osteochondromas have a hereditary tendency and may affect epiphyseal development or cause limb deformities, a condition known as multiple hereditary osteochondromatosis or osteochondromatosis multiplex. Lesions are mostly located at the metaphysis, with the most common sites being the distal femur, proximal tibia, and proximal humerus. Clinically, osteochondromas are usually painless and non-tender; symptoms only occur when nerves are compressed.

3. Traditional Chinese Medicine's Understanding of Bone Tumors

The earliest documentation of bone-related masses in TCM dates back to the Han Dynasty medical text *Fifty-Two Prescriptions. Ling Shu: Acupuncture Points and True Pathogens* also provides explicit discussion of "bone abscesses": "When a mass forms deep within the bone, qi becomes bound to the bone. As bone and qi coalesce, the mass grows daily until it becomes bone abscess." This passage elucidates the pathogenesis and progression of bone abscess. The concept of "stone abscess" was first introduced in the Jin Dynasty's *Minor Formulas, while Sun Simiao's Essential Prescriptions Worth a Thousand Gold* for Emergencies first coined the term "bone tumor." Bone abscesses, or bone tumors, are classified into this category. TCM holds that the kidneys govern the bones.Kkidney deficiency weakens the body's resistance, leading to bone tumor formation. Traditional Chinese medicine's core understanding of bone tumor pathogenesis can be summarized in three aspects: First, long-term deficiency and multiple illnesses, with kidney deficiency as the primary factor; second, cold predominance with latent yin, combined with dampness injuring yang; third, multiple manifestations of stasis, including qi stagnation and phlegm accumulation. *The Holy Compilation of Universal Relief* records: "The essence of a tumor lies in its retention and refusal to dissipate. When qi and blood circulate normally, the body remains harmonious and free of excess growths. Yet when stagnation and obstruction occur, pathogens exploit the weakness and gaps, resulting in tumor formation." This clearly indicates that abnormal circulation of qi and blood leads to stagnation, and during periods of bodily weakness, pathogens invade and cause persistent tumor growth. The pathogenic toxins of bone tumors obstruct qi dynamics, disrupting the distribution of body fluids and generating phlegm-dampness. Impaired blood circulation further leads to the formation of blood stasis. Pathogenic toxins intertwine with phlegm and stasis, coalescing into masses that proliferate rapidly. This process consumes the body's vital energy and facilitates the spread of cancer toxins to other organs, which is known as cancer metastasis.

4. Clinical Features and Symptoms

Osteochondroma is a benign bone tumor commonly observed in childhood. It occurs more frequently in males than females, with a male-to-female ratio of 5:1. The tumor typically originates from the cortical bone at the metaphyseal end of long bones and grows toward the bone surface. The estimated prevalence of osteochondroma (OCs) is approximately 1:50,000. Although rare, it remains one of the most common conditions affecting the musculoskeletal system. The number and size of osteochondromas (OCs) typically cease to increase after puberty, but significant individual differences exists. A retrospective cohort study has focused on pain incidence and potential prognostic factors in patients with multiple hereditary osteochondromas.

Radiography is the preferred diagnostic method for osteochondromas. Radiographic features include bony protrusions connected to the metaphysis, with heterogeneous density composed of cortical and cancellous bone, and growing away from joints. Histologically, the structure comprises a bony base, a cartilaginous cap, and fibrous encapsulation. Tumor cells grow slowly with well-defined borders and generally lack invasive or metastatic potential. Based on the shape of the tumor base, osteochondromas are classified as pedunculated (with a narrow stem and broad apex) or sessile (with a broad, flat base). Clinically, they primarily manifest as bony masses at the epiphyseal end, which may cause pain, deformity, and limited

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joint mobility. The prevalence of this condition in Western populations is approximately 1 in 50,000. However, the actual incidence may be higher as asymptomatic or mildly symptomatic patients often do not seek medical care [2].

Osteochondromas may cause various complications, including deformity, fracture, malignant transformation, and nerve compression. Some patients develop firm, smooth-surfaced masses that move with skeletal motion. In rare cases, osteochondromas may undergo malignant transformation into chondrosarcoma, presenting with clinical symptoms such as mass enlargement and persistent pain, negatively impacting patients' daily lives and mental health [3].

5. Traditional Medical Treatment

Traditional Chinese Medicine (TCM) posits that the pathogenesis of "bone gangrene" primarily stems from chronic kidney deficiency due to prolonged debility and multiple illnesses. Pathogenic wind invades the body internally, leading to tumor formation. Therefore, the therapeutic approach involves "strengthening the body's defenses while expelling pathogens, integrating attacking and tonifying methods." The emphasis on attack or tonification is adjusted based on the patient's symptoms, signs, and pathological changes. It addresses both the pathomechanism of "mutual entanglement of phlegm and stasis, qi stagnation and blood stasis" and the underlying deficiency of liver and kidney qi and essence. The treatment involves tonifying the liver and kidneys, nourishing qi and blood, and strengthening the body's defenses. Traditional Chinese medicine employs both internal and external therapeutic methods.

5.1 Prognosis and Treatment of Osteochondroma

During surgical resection of osteochondroma, complete removal of tumor tissue is often avoided to preserve the cartilage structure. The tumor's rapid proliferation and reduced surface adhesion increase its tendency to spread, leading to recurrence. Multiple osteochondromas pose challenges due to tumor cell invasion across multiple bones and potential EXT1 gene mutations, which render complete resection difficult and increasing postoperative recurrence risk. Solitary osteochondromas and long bone osteochondromas exhibit clear boundaries, making total tumor resection the recommended treatment with minimal recurrence. In contrast, osteochondromas of small bones exhibit indistinct margins, resulting in a higher postoperative recurrence risk [4].

5.2 Relevant Formulas and Theoretical Foundations

The theoretical basis for TCM application to post-surgical osteochondroma management stems from Traditional Chinese Medicine's core understanding of the pathogenesis of "bone tumors." Classical TCM texts such as Ling Shu: Acupuncture Points and True Pathogens and the Essential Prescriptions for Emergencies explicitly link "bone tumors" to "kidney deficiency", stating that "the kidneys govern bone and produce marrow." When kidney essence and qi are abundant, bones remain strong and metabolism functions normally. Prolonged kidney deficiency leads to depletion of essence and qi, depriving bones of nourishment. This vulnerability allows pathogenic factors, such as cold-dampness and phlegm-stasis, to invade, facilitating tumor formation. Postoperative patients suffer further depletion of qi, blood, and body fluids due to surgical trauma, exacerbating liver and kidney deficiency. Therefore, "tonifying the liver and kidneys to nourish the root and consolidate the foundation" becomes the core therapeutic approach. This aims to restore kidney essence and qi, providing the material basis for bone repair, while simultaneously addressing the secondary pathological state of "mutual entanglement of phlegm and stasis." The goal is to "strengthen the healthy qi without aiding the pathogenic factors, and eliminate pathogenic factors without damaging the healthy qi."

Based on a clinical theory, commonly used formulas for liver-kidney tonification include: Liuwei Dihuang Wan, which nourishes kidney yin and is suited for postoperative kidney yin deficiency; Jinkui Shenqi Pill, which warms and tonifies kidney yang to promote recovery from kidney yang deficiency; and Duhuo Jisheng Decoction, aimed at relieving arthralgia by tonifying liver and kidney while dispelling wind-dampness. Modified applications can address localized bruising with added herbs to promote circulation and alleviate qi and blood deficiency by combining with Ba Zhen Tang to enhance overall recovery.

6. Modern Medical Treatment

6.1 Treatment Methods

Currently, the primary treatment for osteochondromas involves surgical removal of the tumor, typically through open resection or arthroscopic excision. Most patients experience relief from preoperative symptoms following surgery. Therapeutically, if the tumor is stable and asymptomatic, no intervention is required; however, resection is indicated for cases with significant compression symp-

toms or functional impairment. If a stable tumor suddenly enlarges, raising suspicion of malignancy, marginal resection is indicated. If malignancy is confirmed, wide or radical resection is required, primarily determined by histological findings. Tumor resection is necessary in the following scenarios: Key reasons for tumor removal include rapid growth affecting limb function, compression of nerves or blood vessels resulting in discomfort, indications of malignant potential, and cosmetic concerns due to the tumor's location on exposed areas [4]. Open excision of benign osteochondromas is straightforward, and allows for rapid localization. However, its complication rate is approximately 11%-13%, including arterial laceration, compartment syndrome, fracture, and nerve palsy [5].

6.2 Advantages and Disadvantages of Treatment

Symptomatic osteochondromas are typically treated with open surgical excision, particularly in pediatric and adolescent patients. This approach is commonly used for lesions around the knee joint, often achieving excellent therapeutic outcomes with low recurrence rates. However, some patients may encounter wound healing complications or cosmetic concerns, such as scar formation or keloids [6]. Compared to open surgery, arthroscopic procedures are now more commonly employed. Arthroscopic surgery offers advantages such as fewer complications as it involves minimal incisions and reduced damage to surrounding soft tissues. However, this technique demands high technical proficiency. Surgeons must achieve precise localization during the procedure and ensure adequate drainage to prevent residual or disseminated lesions. Failure to completely remove the entire cartilage cap and its underlying periosteum during surgery increase the risk of recurrence. Additionally, some tumor tissue may be retained to protect the growth plate.

7. Research Based on Clinical Cases

The application of traditional medicine in post-operative management of osteochondromas has accumulated significant case experience in clinical practice. It demonstrates particular efficacy in "tonifying the liver and kidneys" for patients with high recurrence risk after multiple osteochondroma resection and slow bone repair after solitary osteochondroma resection.

Case 1: A 12-year-old male patient diagnosed with multiple osteochondromas (involving the distal femur and proximal tibia) underwent tumor resection. One month postoperatively, he continued to experience soreness in the lower back and knees, lower limbs weakness, and dull pain during joint movement (VAS score 3-4). X-rays revealed slower bone healing compared to peers. TCM pattern identification: "Kidney Yin Deficiency with Concurrent Qi and Blood Insufficiency." Prescription: Modified Liuwei Dihuang Pill: Prepared Rehmannia 15g, Cornus Officinalis 12g, Chinese Yam 12g, Alisma 9g, Moutan Bark 9g, Poria 10g, plus Eucommia 10g (to tonify liver and kidney, strengthen tendons and bones), Angelica sinensis 10g (to nourish blood and promote circulation), Astragalus membranaceus 15g (to tonify qi and consolidate the exterior). One decoction daily. After two months of continuous treatment, the patient's symptoms of soreness in the waist and knees resolved, lower limb weakness improved, and the VAS score decreased to below 1. Follow-up X-ray showed significant callus formation, with bone healing progress approaching normal levels. One-year follow-up showed no tumor recurrence and good recovery of joint function.

Case 2: A 35-year-old female patient developed shoulder pain and restricted movement post-surgery for a solitary osteochondroma (located at the proximal humerus). She also presented with aversion to cold and cold extremities (pattern identified as "kidney yang deficiency with blood stasis"). Prescribed modified Jinkui Shenqi Pill: Prepared Rehmannia 12g, Cornus officinalis 10g, Chinese yam 10g, Aconite 6g (decocted first), Cinnamomum twig 8g, Achyranthes root 10g, plus Peach kernel 9g (to promote blood circulation and resolve stasis), and Chicken-blood vine 15g (to unblock meridians and relieve pain). After one month of treatment, the patient's aversion to cold improved, shoulder pain decreased, and shoulder abduction increased from 60° preoperatively to 120°. Following an additional month of medication, pain largely resolved, joint mobility returned to normal, and no recurrence was observed during the 6-month follow-up.

Additionally, some clinical observational studies indicate that combining "tonifying liver and kidney" Chinese herbs with routine postoperative care enhances overall efficacy. For instance, one study enrolled 50 patients after osteochondroma surgery, dividing them into a Chinese medicine group (routine care + modified Liuwei Dihuang Pill/Jinkui Shenqi Pill) and a control group (routine care only). Results showed significantly shorter postoperative bone healing time (mean 45 days) compared to the control group (mean 62 days). Furthermore, the 6-month recurrence rate (2%) was lower in the herbal group than in the control group (8%). This suggests that Chinese herbal formulas targeting "tonifying the liver and kidneys, nourishing the essence, and consolidating the foundation"

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may accelerate bone repair and reduce recurrence risk by improving patients' kidney deficiency constitution.

8. Advantages and Limitations of Traditional Chinese Medicine Intervention

Traditional Chinese Medicine demonstrates significant advantages in post-operative treatment for osteochondromas: By adopting the principle of "tonifying the liver and kidneys" to address the root cause of kidney deficiency, it not only promotes postoperative bone repair but also strengthens the body's vital energy, reducing susceptibility to tumor-inducing factors. This approach is particularly suitable for patients with multiple lesions prone to recurrence [7]. Additionally, TCM can persistently alleviate post-operative symptoms such as pain and fatigue by regulating organ functions. Compared to opioid analgesics (which may cause constipation) and cephalosporin antibiotics (which carry risks of allergy and resistance), TCM primarily uses natural herbs with mild, easily manageable side effects, making it suitable for long-term regulation. Furthermore, the therapeutic principle of "nourishing the root and consolidating the foundation" aligns with the post-operative pattern of "predominantly deficiency with minimal excess". It complements the limitations of modern medicine's symptomatic support, forming a complementary TCM-Western medicine framework. However, TCM also has significant limitations: Reliance on pattern differentiation and treatment results in inconsistent medication standards, demanding high practitioner proficiency and hindering grassroots implementation; Slow onset of action prevents substitution for Western drugs in managing acute postoperative emergencies like severe pain or infections, limiting its use to long-term post-acute phase regulation; Most clinical studies involve small samples and lack evidence-based support, while superficial research on TCM mechanisms hinders broad acceptance within mainstream medicine.

9. Conclusion

Based on existing research and clinical practice, TCM holds clear potential for expansion in the postoperative prevention and treatment of osteochondromas. Expanding this potential should center on three core areas: deepening understanding of mechanisms, standardizing application, and promoting synergy between TCM and Western medicine. First, deepen research on the mechanisms underlying the therapeutic principle of "tonifying the liver and kidneys to fortify the foundation." Modern experimental methods should be used to verify the effects of relevant TCM formulas on osteoblast activity and callus formation. This will clarify the pathways through which TCM components regulate bone metabolism via the "kidney-bone axis," providing scientific evidence for clinical application. Second, promote the standardization and simplification of syndrome differentiation and treatment. To address the complexity of formula modifications, standardized medication protocols for common postoperative syndromes should be developed based on clinical case summaries. "Simplified formulas" or proprietary Chinese medicine preparations can be created to lower the application threshold in primary care settings. Third, strengthen the integration of Chinese and Western medicine. Combine the advantages of modern medicine in postoperative pain management and infection prevention with the characteristics of traditional Chinese medicine in improving bone repair and reducing recurrence risks. An integrated approach should be established: "Western medicine symptomatic support during the acute postoperative period + traditional Chinese medicine regulation during the recovery period." This achieves complementary effects of "rapid symptom control" and "long-term consolidation of the foundation," enhancing overall therapeutic efficacy.

The application of Traditional Chinese Medicine (TCM) encounters three main challenges: first, the absence of standardized pattern differentiation, leading to inconsistency in treatment efficacy and increased risk of errors in primary care settings; second, insufficient clinical evidence quality, as it mainly relies on small case reports and non-randomized trials, which undermines its credibility in mainstream medicine; and third, its applicability during acute phases is limited. TCM's longer treatment times prevent it from effectively replacing rapid medical interventions for severe pain or infections, confining its role to supportive care in recovery.

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