Effect of the Jintiange capsule-assisted internal fixation on fracture healing and bone metabolism activity of patients with Colles fracture

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ABSTRACT

Objective: To study the effect of the Jintiange capsule-assisted internal fixation on fracture healing and bone metabolism activity of patients with Colles fracture. Methods: A total of 120 patients with Colles fracture who received internal fixation in the hospital between July 2014 and May 2016 were collected and divided into control group and observation group according to the random number table method, 60 cases in each group. The control group received regular open reduction and internal fixation, and the observation group received Jintiange capsule-assisted internal fixation. The fracture healing quality as well as calcium phosphorus metabolism index and bone metabolism index levels were compared between the two groups before and after the operation. Results: Before operation, the differences in fracture end parameter levels, peripheral blood calcium and phosphorus metabolism index contents and serum bone metabolism index contents were not statistically significant between the two groups of patients; differences in fracture end radial incline, ulnar inclination and processus styloideus radii height were not statistically significant between the two groups of patients 6 weeks after surgery; peripheral blood Ca, P and ALP contents of observation group 6 weeks after surgery were significantly higher than those of control group, and serum bone formation indexes BGP and OPG contents were higher than those of control group while bone resorption indexes TRACP and CTX contents were significantly lower than those of control group. Conclusions: Jintiange capsule-assisted internal fixation can effectively improve the calcium and phosphorus metabolism, optimize bone formation/bone resorption balance and promote fracture healing in patients with Colles fracture.

1. Introduction

Colles fracture refers to the cancellous bone fracture in the lower radius, accounting for about 10% of all fractures, and is mostly caused by the back palm lading after falling on flat ground, wrist joint in dorsal extension and forearm intorsion position[1,2]. With the development of internal fixation technology, open reduction and internal fixation has become the most common therapy for Colles fracture patients with fracture end displacement, and it has obtained definite curative effect. But some patients show poor healing of fracture end, wrist joint dysfunction after fracture healing, etc.[3,4]. How to expand the curative effect of Colles fracture and improve patients’ quality of life is the key of the current clinical research. Jintiange capsule is the new traditional Chinese medicine made from the specific areas of bones from non-protective animals, which has the effect of strengthening tendons and bones and is considered to be used in the adjuvant treatment of clinical fracture patients; but there are not many researches on the value of Jintiange capsule for the treatment of Colles fracture. In this study, both routine internal fixation and Jintiange capsule were introduced in the treatment of patients with Colles fracture, and the application value was discussed from fracture healing quality, calcium phosphorus metabolism, bone metabolism indexes and other aspects.
2. Materials and methods

2.1. Case information

A total of 120 patients with Colles fracture who received internal fixation in the hospital between July 2014 and May 2016 were selected as the study subjects, and the patients themselves signed the informed consent. Inclusion criteria: (1) patients diagnosed with Colles fracture by X-ray examination; (2) with single fracture and accompanied by fracture end displacement; (3) with fracture in the area for the first time; (4) without history of surgical operation within 6 months prior to admission. Exclusion criteria: (1) with pathological fracture; (2) with history of long-term glucocorticoid application; (3) combined with systemic infectious diseases.

According to the random number table method, the patients with Colles fracture were divided into control group and observation group, each with 60 cases. Control group included 34 men and 26 women that were 37-72 years old; observation group included 32 men and 28 women that were 35-76 years old. There was no significant difference in gender and age distribution between the two groups ($P > 0.05$), and the hospital ethics committee approved the study.

2.2. Therapy

Control group received regular open reduction and internal fixation for Colles fracture and observation group of patients, on the basis of routine internal fixation, received adjuvant Jintiange capsule therapy, specifically as follows: Jintiange capsule (Ginwa Enterprise Inc. Xi’an Ginwa Pharmaceutical Factory, approved by Z20030080) 3 capsules/time, 3 times/d for continuous 6 weeks of treatment.

2.3. Observation indexes

2.3.1. Fracture healing quality

Before operation and 6 weeks after operation, the affected limb radial incline, ulnar inclination and processus styloideus radii height of two groups of patients were determined to evaluate the healing quality.

2.3.2. Calcium phosphorus metabolism indexes

Before operation and 6 weeks after operation, 2.0 mL of peripheral blood was extracted from two groups of patients and anti-coagulated, and then the automatic biochemical analyzer (Toshiba Medical Systems Corporation, model TBA-40FR) was used to determine calcium (Ca), phosphorus (P) and alkaline phosphatase (ALP) levels.

2.3.3. Bone metabolism indexes

Before operation and 6 weeks after operation, 2.0 mL of peripheral blood was extracted from two groups of patients in the same way; anti-coagulated and then centrifuged at low speed to get upper serum, and enzyme-linked immunosorbent assay was used to determine the levels of bone formation markers bone gla protein (BGP) and osteoprotegerin (OPG) as well as bone resorption markers tartrate-resistant acid phosphatase (TRACP) and collagen C-terminal peptide (CTX).

2.4. Statistical processing

Statistical software was SPSS 24.0. Radial incline, ulnar inclination, processus styloideus radii height, calcium phosphorus metabolism indexes, bone metabolism indexes and other measurement data were in terms of mean ± standard deviation, and comparison was by t test. $P < 0.05$ was the standard of statistical significance in differences.

3. Results

3.1. Fracture healing quality

Comparison of fracture healing quality indexes radial incline ($\circ$), ulnar inclination ($\circ$) and processus styloideus radii height (mm) levels between two groups of patients before and after surgery was as follows: before operation, the differences in radial incline, ulnar inclination and processus styloideus radii height were not statistically significant between the two groups of patients ($P > 0.05$); 6 weeks after surgery, radial incline, ulnar inclination and processus styloideus radii height of both groups were significantly higher than those before surgery ($P < 0.05$), but differences in radial incline, ulnar inclination and processus styloideus radii height between the two groups were not statistically significant ($P > 0.05$), shown in Table 1.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Radial incline</th>
<th>Ulnar inclination</th>
<th>Processus styloideus radii height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before surgery</td>
<td>6 weeks after surgery</td>
<td>Before surgery 6 weeks after surgery</td>
<td>Before surgery 6 weeks after surgery</td>
</tr>
<tr>
<td>Control group</td>
<td>-11.28±2.03</td>
<td>12.86±1.94</td>
<td>17.22±2.19</td>
</tr>
<tr>
<td>Observation group</td>
<td>-11.35±2.14</td>
<td>13.28±1.76</td>
<td>17.16±2.53</td>
</tr>
<tr>
<td>$t$</td>
<td>0.281</td>
<td>0.164</td>
<td>0.175</td>
</tr>
<tr>
<td>$P$</td>
<td>$&gt;0.05$</td>
<td>$&gt;0.05$</td>
<td>$&gt;0.05$</td>
</tr>
</tbody>
</table>

Note: compared with same group before surgery, $P < 0.05$. 

Table 1. 

Comparison of healing quality between two groups of patients ($n=60$).
3.2. Calcium phosphorus metabolism indexes

Comparison of peripheral blood calcium phosphorus metabolism indexes Ca (mmol/L), P (mmol/L) and ALP (U/L) contents between two groups of patients before and after surgery was as follows: before operation, the differences in peripheral blood Ca, P and ALP contents were not statistically significant between the two groups of patients ($P>0.05$); 6 weeks after surgery, peripheral blood Ca, P and ALP contents of both groups were significantly higher than those before surgery, peripheral blood Ca, P and ALP contents of observation group were significantly higher than those of control group, ($P<0.05$), shown in Table 2.

3.3. Bone metabolism indexes

Comparison of serum bone metabolism indexes BGP (ng/mL), OPG (pg/mL), TRACP (U/L) and CTX (ng/mL) contents between two groups of patients before and after surgery was as follows: before operation, the differences in serum BGP, OPG, TRACP and CTX contents were not statistically significant between the two groups of patients ($P>0.05$); 6 weeks after surgery, serum bone formation indexes BGP and OPG contents of both groups were higher than those before surgery while bone resorption indexes TRACP and CTX contents were lower than those before surgery; serum bone formation indexes BGP and OPG contents of observation group were significantly higher than those of control group while bone resorption indexes TRACP and CTX contents were significantly lower than those of control group ($P<0.05$), shown in Table 3.

### Table 2.

Comparison of peripheral blood calcium phosphorus metabolism index contents between two groups of patients before and after surgery ($n=60$).

<table>
<thead>
<tr>
<th>Groups</th>
<th>Ca</th>
<th>P</th>
<th>ALP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before surgery</td>
<td>6 weeks after surgery</td>
<td>Before surgery</td>
</tr>
<tr>
<td>Control group</td>
<td>2.16±0.27</td>
<td>2.26±0.29</td>
<td>1.40±0.17</td>
</tr>
<tr>
<td>Observation group</td>
<td>2.14±0.25</td>
<td>2.61±0.32$^*$</td>
<td>1.41±0.18</td>
</tr>
<tr>
<td>$t$</td>
<td>0.291</td>
<td>5.392</td>
<td>0.125</td>
</tr>
<tr>
<td>$P$</td>
<td>$&gt;0.05$</td>
<td>$&lt;0.05$</td>
<td>$&gt;0.05$</td>
</tr>
</tbody>
</table>

Note: compared with same group before surgery, $P<0.05$; compared with control group 6 weeks after surgery, $^*$ $P<0.05$.

### Table 3.

Comparison of serum bone metabolism index contents between two groups of patients before and after surgery ($n=60$).

<table>
<thead>
<tr>
<th>Groups</th>
<th>BGP</th>
<th>OPG</th>
<th>TRACP</th>
<th>CTX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before surgery</td>
<td>6 weeks after surgery</td>
<td>Before surgery</td>
<td>6 weeks after surgery</td>
</tr>
<tr>
<td>Control group</td>
<td>3.62±0.45</td>
<td>4.27±0.58</td>
<td>5.07±0.58</td>
<td>6.84±0.76</td>
</tr>
<tr>
<td>Observation group</td>
<td>3.71±0.47</td>
<td>5.63±0.72$^*$</td>
<td>5.09±0.62</td>
<td>8.17±0.95$^*$</td>
</tr>
<tr>
<td>$t$</td>
<td>0.283</td>
<td>7.215</td>
<td>0.162</td>
<td>8.498</td>
</tr>
<tr>
<td>$P$</td>
<td>$&gt;0.05$</td>
<td>$&lt;0.05$</td>
<td>$&gt;0.05$</td>
<td>$&lt;0.05$</td>
</tr>
</tbody>
</table>

Note: compared with same group before surgery, $P<0.05$; compared with control group 6 weeks after surgery, $^*$ $P<0.05$.

4. Discussion

Colles fracture is one of the most common fracture types in clinic, and the reasonableness and efficiency of clinical treatment will directly determine the patients’ long-term wrist function and normal life. Open reduction and internal fixation is the most reasonable and efficient way, but some patients exist poor healing of fracture for Colles fracture patients with fracture end displacement, but there is poor fracture healing in some patients, which is possibly related to the autonomous fracture healing dysfunction and abnormal bone metabolism. Adding other drugs as adjuvant therapy on the basis of internal fixation is an important way to improve the overall curative effect of fracture patients, and the Chinese patent drugs strengthening tendons and bones are recommended by many scholars. Jintiange capsule is a new type of Chinese patent drug that is based on bionics theory, taking the specific chromatogram of tiger bone as the standard, and using the non-protective animal bones as the raw materials, which can be used as tiger bone powder substitute, and has the effects of strengthening tendons and bones, reinforcing the kidney and boosting essence as well as soothing the sinews and quickening the network vessels[9]. In this study, Jintiange capsule is used as the adjuvant drug and introduced in the clinical treatment of patients with Colles fracture so as to clarify its role in promoting fracture healing, improving the quality of healing and other aspects. The affected-side wrist function parameters change after the Colles fracture, and the changes of the parameters after treatment can reflect the fracture healing situation.[10,11]. In the study, wrist joint radial incline, ulnar inclination and processus styloideus radii height levels were first compared between the two groups before and after surgery, and it was found that compared with those before surgery, radial incline, ulnar inclination and processus styloideus radii height of both groups increased, indicating that both kinds of treatments can reverse the anatomical change of affected-side limb and make the fracture end tend to be normal from every angle; the radial incline, ulnar inclination and processus styloideus radii height of observation group 6 weeks after surgery were not significantly different from those of control group, and it is mainly directly related to the same operation method and postoperative functional position fixation operation of the two, and therefore, micro indexes have to...
be compared to clarify the value of the auxiliary Jintiange capsule therapy.

Calcium and phosphorus metabolism disturbance is one of the important reasons for the poor quality of postoperative fracture healing, and severe cases may lead to difficult bone tissue mineralization[12]. Ca is an important element in regulating the acid-base balance in the internal environment, maintaining cellular osmotic pressure and increasing the mechanical strength of bones, and it also plays a key role in the healing process of fractures[13]. The contents of calcium and phosphorus in serum are restricted mutually, and the bone salt deposit can only be formed when the product of their contents is more than certain limit. Therefore, the decrease of Ca or P content can lead to poor fracture healing. Osteoblast can secrete ALP, and the increase in its content is a sign of increased activity of osteoblasts, which represents the vigorous bony remodeling[14]. In the study, the contents of calcium and phosphorus metabolism indexes in serum were compared between the two groups before and after operation, and it was found that peripheral blood Ca, P and ALP contents of both groups after surgery were higher than those before surgery; peripheral blood Ca, P and ALP contents of observation group 6 weeks after surgery were higher than those of control group, confirming that adjunct Jintiange capsule therapy can effectively optimize the calcium phosphorus metabolism in patients with Colles fracture, and lay a foundation for subsequent bone formation.

Bone metabolism includes bone formation and bone resorption, and its equilibrium state can directly affect the final fracture healing speed and quality. There are many metabolites in serum that represent bone formation and bone resorption, which can be used for indirect judgment of fracture healing process. BGP can be specifically combined with hydroxyapatite to make bone salt deposit and increase bone salt content, and BGP content increases when osteoblast function is enhanced, and decreases on the contrary[12]. OPG is a member of the tumor necrosis factor receptor superfamily; it can inhibit osteoclasts and inhibit bone resorption, and its high expression can indirectly promote the bone formation[15]. TRACP is a newly discovered bone resorption index, and its content can reflect osteoclast activity; the patients can show osteosclerosis and osteoporosis when TRACP is over-expressed[16]. CTX is secreted by osteoclasts; its content can reflect osteoclast activity, and its high expression is one of the risk factors for poor fracture healing[17]. In the study, the bone metabolism index contents in serum were compared between the two groups before and after surgery, and it was found that serum bone formation indexes BGP and OPG contents of both groups 6 weeks after surgery were higher while bone resorption indexes TRACP and CTX contents were lower than those before surgery; serum bone formation indexes BGP and OPG contents of observation group 6 weeks after surgery were higher while bone resorption indexes TRACP and CTX contents were lower than those of control group, confirming that adjunct Jintiange capsule therapy can effectively promote bone formation and relatively reduce bone resorption to guide the fracture healing process eventually.

Adjuvant Jintiange capsule therapy on the basis of open reduction and internal fixation can effectively optimize the calcium and phosphorus metabolism, promote bone resorption, eventually accelerate fracture healing and improve the quality of healing in patients with Colles fracture, and it is worth popularization and application in clinical practice in the future.

**References**


