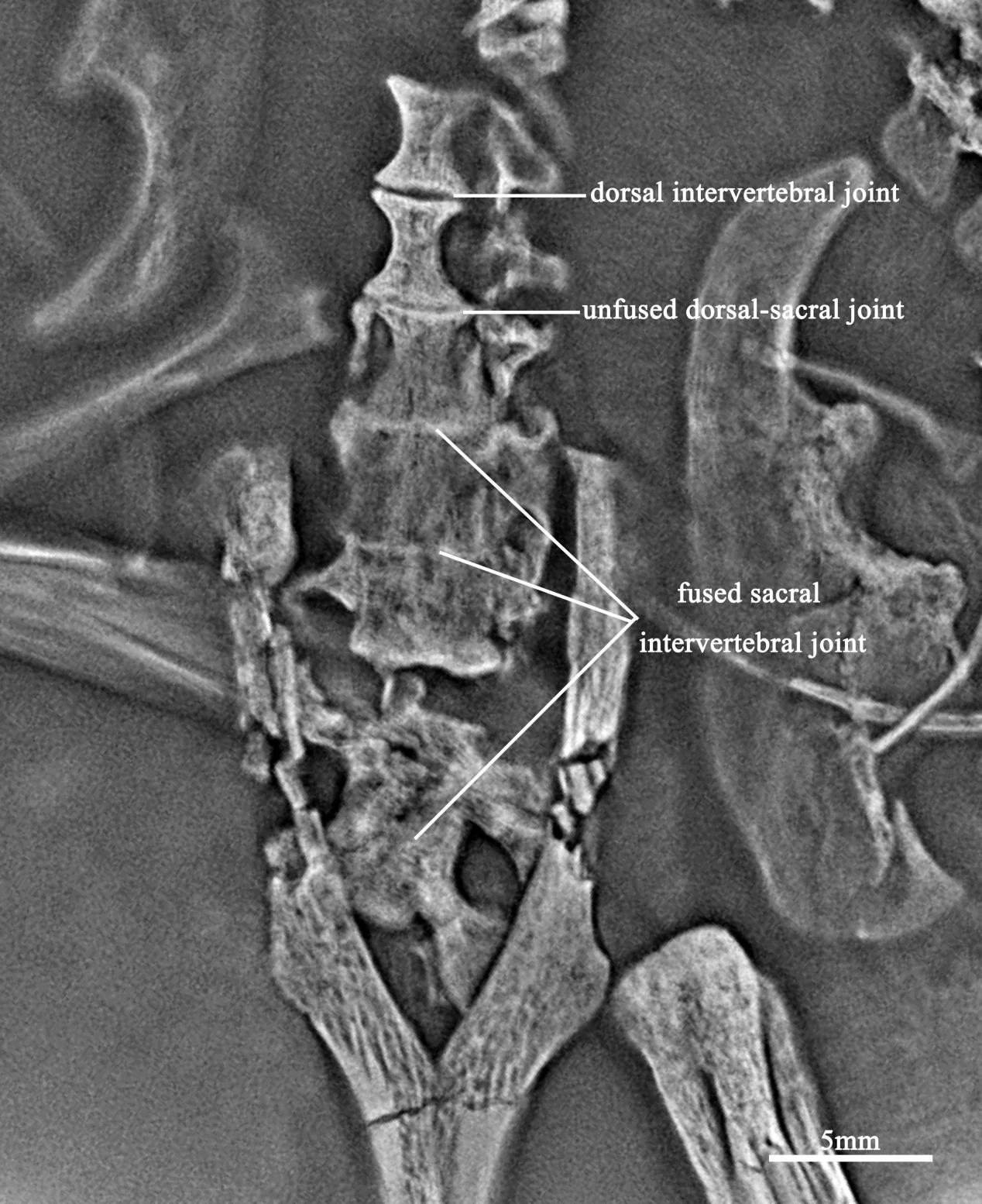
**Table S1. Skeletal measurents (in mm) of IVPP V 31612**

|  |  |  |
| --- | --- | --- |
| Element | Left | Right |
| Scapula | 32.5 | 32.0 |
| Coracoid | 14.2 | ＞12.0 |
| Humerus | 41.0 | ? |
| Radius | 32.2 | ? |
| Ulna | 32.8 | ? |
| Metacarpal II | 6.4 | ? |
| Manual phalanx 1 | 14.0 | ? |
| Manual phalanx 2 | 10.3 | ? |
| Metacarpal III | 20.8 | ? |
| Manual phalanx 1 | 10.8 | ? |
| Manual phalanx 2 | 11.5 | ? |
| Manual phalanx 3 | 9.9 | ? |
| Metacarpal IV | 20.6 | ? |
| Manual phalanx 1 | 8.5 | ? |
| Manual phalanx 2 | 3.0 | ? |
| Manual phalanx 3 | 8.2 | ? |
| Manual phalanx 4 | 5.5 | ? |
| Ilium | 29.1 | 28.2 |
| Pubis | 41.8 | 42.8 |
| Ischium | 18.0 | 17.0 |
| Femur | 46.5 | 48.1 |
| Tibia | 65.1 | 62.5 |
| Fibula | 63.4 | 62.0 |
| Metatarsal I | 5.2 | 5.2 |
| Pedal phalanx 1 | 4.0 | 4.0 |
| Pedal phalanx 2 | 3.5 | 3.9 |
| Metatarsal II | 31.0 | 30.5 |
| Pedal phalanx 1 | 4.9 | 4.9 |
| Pedal phalanx 2 | 5.0 | 5.0 |
| Pedal phalanx 3 | 9.3 | ? |
| Metatarsal III | 33.2 | 33.0 |
| Pedal phalanx 1 | 8.0 | ? |
| Pedal phalanx 2 | 4.8 | ? |
| Pedal phalanx 3 | 5.0 | 4.8 |
| Pedal phalanx 4 | 5.7 | 6.0 |
| Metatarsal IV | 33.0 | 33.0 |
| Pedal phalanx 1 | 6.0 | ? |
| Pedal phalanx 2 | 3.8 | ? |
| Pedal phalanx 3 | 3.5 | 2.9 |
| Pedal phalanx 4 | 3.5 | 3 |
| Pedal phalanx 5 | 5.9 | ? |
| Metatarsal V | 31.0 | ＞17.5 |

**Figure S1. CT scan image of sacral vertebrae of IVPP V 31612**



**Phylogenetic analysis**

**1. Character list**:

The character list includes 1864 characters, which can be referenced from Wang et al. (2022).

**2. Matrix**:

The scores for IVPP V 31612 and the matrix with revised scores based on first-hand observations of the holotypes are provided below, while matrices for other taxa are referenced from Wang et al. (2022).

*Changyuraptor*

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*Daurlong* 1000?0?0???0????0?0?1101?000??001000000000?0???10000?101????1???????11?????????????????00???010?????????????????????????????????????????????????????0??0?0???1000??????????????1?????????????????????????????????????????????0?????????00??00????1??0??0?01111000??00?????1000?0100??1??0?????0?0101?011?111101???0101?111011???11?001?0??10111???????1???0?????1?1???????10?1????001???111???????????1??????1??1????0?1?????????0??1????0??0????????????????????????????????????????????????1??????????11?0??????????0??????1???????0??????1??0??010???0???11?0??1???????????1??????????????????????????0????0?????0??????????????????????0?0????1?1????????????0????????????1??01?0??0?1???????????????????0????0?????10????00?????????????????????1????00????????1???????0??0?????????????????????0????????01??0??????????0???????11????????0?????????????00??0????0?????????0?????????0??????????????0???????????1?????????1??10000????????????1???????000?????????????????????0??1???????????0????0???????????????????0?????1????????????????????????00??????????1?????1??????????1?0????????????????0?????????????0???????0??0?????????0??0???????0????0????0?????????????1????????0??????????????1?0???????????0?????????????????????????????0???????0??00???????0???????????????0????1?????????????????????????????????00???????????????????????????0???0?0??0?????????1???????????????????????????????????1??????0????????0??????00????????0?????????????????????00??????????????01??????0???1?????0???????????????????????????????0?????????????0????????00?0?????????????????????????????????????????????????????????0??????????????????????????????????????????????????????0????????0???0????????????????????00???????????????????????????????????1??00???????111000000?????0?10??0001?00????0????????????????????????1?????0????0????0??????????????????????????????????1??????0??0???????????????????0??????????????????01

*Graciliraptor*

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*Microraptor* 100100?10000001?0?001101?000??00??0010?00000000?00?0?10100?11001110?1?????00?????????0???????????0?1?1?000110???????????????????????????????????????00?0?00000010?000?1001101??1001?????0?0?0????0?????????????10?100??????01??0010???00???0010?11?10??00010110011101??1??1?00011000000000???00?01000011?111101???010101101110??11?01110??11?11010?0011??1?001?111110?????1??10?00001010101000000000011001??101?11?10?11??0100000010111?0001?01011010?0??1???000???1???0?01??0??1?01111?1100110011101100110010010011001110101111111110?11??0????0?010??01?1?11?01?10?001??????10???1??0??001??00???0?0?010?0?00??10000??000101101?001???1?00000?1?1110???0?0???000??00??11????00?01?00?001??????00????1????0?111??00?0??00??0000????1???????000???0?01?0????0??0????1???????10?10??0?0???11???0????000?0?1?0?011??????00??0110?01?10?111???0???0???0?????011111?00?????0????????01?0??????00????00?????0?0?1?100???0010??10??0010?0000?0000000?0?1?0?0???01000??0???0???????????1??0??0?0???000???0??000???0???00???1?0????00????1?01???1???000?0???0?????00?0???0???110????11?0??????0100????1????1?0????0??10??0??0?0?????????00?1?0101?01?0010?01001010?0?00?00?????0???0??00??0???1??01??0??0???????1?0????00?????0??????????0??????1???????????0??0?0??0??0?0??????0????01????0??0?????01???1?????????????0???????????????000?00??0??000??????????0????0?0?000?10????????01???0???????0??????0?100?0???1?0???11?0??000?0?00??00?1?10?110??0?1?000??????????0????0?1?0000????00??0010101??1??10??1110?0??????00????0?0??0?????????????0?00???0?0???0??0?001010000001010?10?0??00???????0??????0?????????????1?0???1?????0?0??????01??1??10?00???????1?????10????????0???0??000?????0???0????00???0???1?0??????0??????00???0?0????????00????????????1????10?11000??????11?000000?00???010???00110???????0?0????????????????1???1?????????000???001?????0???00?????11???00????????????00??00????????000???00??0?000?0??????0???0?0?001

*Sinornithosaurus* 1010?0?100?0?01?0?001101101???001000001000?0000100?0?10100001?????????001000?011000?0??0000?0??0000??10??011??0???????????0???????????????1?1?1?????00?0000000000?0001100001???1?11????100011?11??????????????????1?????????????????????????????????????0?10110011101001001?0001?00??0??0?????0??101?0?1??11101?0?010101101110??10?01110??10110010?0011??0?00????????????????1?????????010100???0???011001?1?0?1111100110?01000?0?1011100001???????10????????????????????????0??1???111?10001?00111?110011?0100100110011101011??????100?10?01???0?0100001?1??1?00?10?001??????1???11?????001?1??1??0??0??0??????0??000000??10?1?01??10?01?00000?1?11?????0??0???00?00???11?0??00?01?00?0?1??????00????1??????110?00??00?00??0000???11???????000??????1????000??1????1???????01?0???0?0???11???0??????0???1?0??11??????01???1?0?0??1?1111???????0????1??????1?10?0?????00????????0??0??????00??1?0?????0?000??100???1010???0?0??100?000?0??0??0?0?100??????10????????0????????????0?0?????0???0??100??000???0???0????1???????0??1????1???0?????????????????0??0???0????1?????1?1??1?0??0100???01????1?????00?010???????0?????????00?1??00?001?00000010011??0??00?0?0???????0??11???0??01??0???0?00???????1?0????00?????0?????????????????1???????????0????0??0????0??????0????0????????0?00???11?0?1??????11????0????????????????00?????0??00???????????0??????0?0?0?00????????010000?0????????0???????????0???????11?0???0000?0???00???10?11?????1?000????0??????????0?1???00????00???010?01??1???0?011???01??????0??????00?0???????????????????????10?0??000?101?0000?10?0?1???0?00???????0??????0??????????????10???01????0?0??0????1??1??10??0??1??????????10????????0?????????????????????????????????????????0??????00????????????????????????????0????????????????0?110000000?00?0?010?????11?????????0?????????????????1???1?????????000???00?1????????00????0????????????????????0??00???????0000????0???????????????????0??????

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