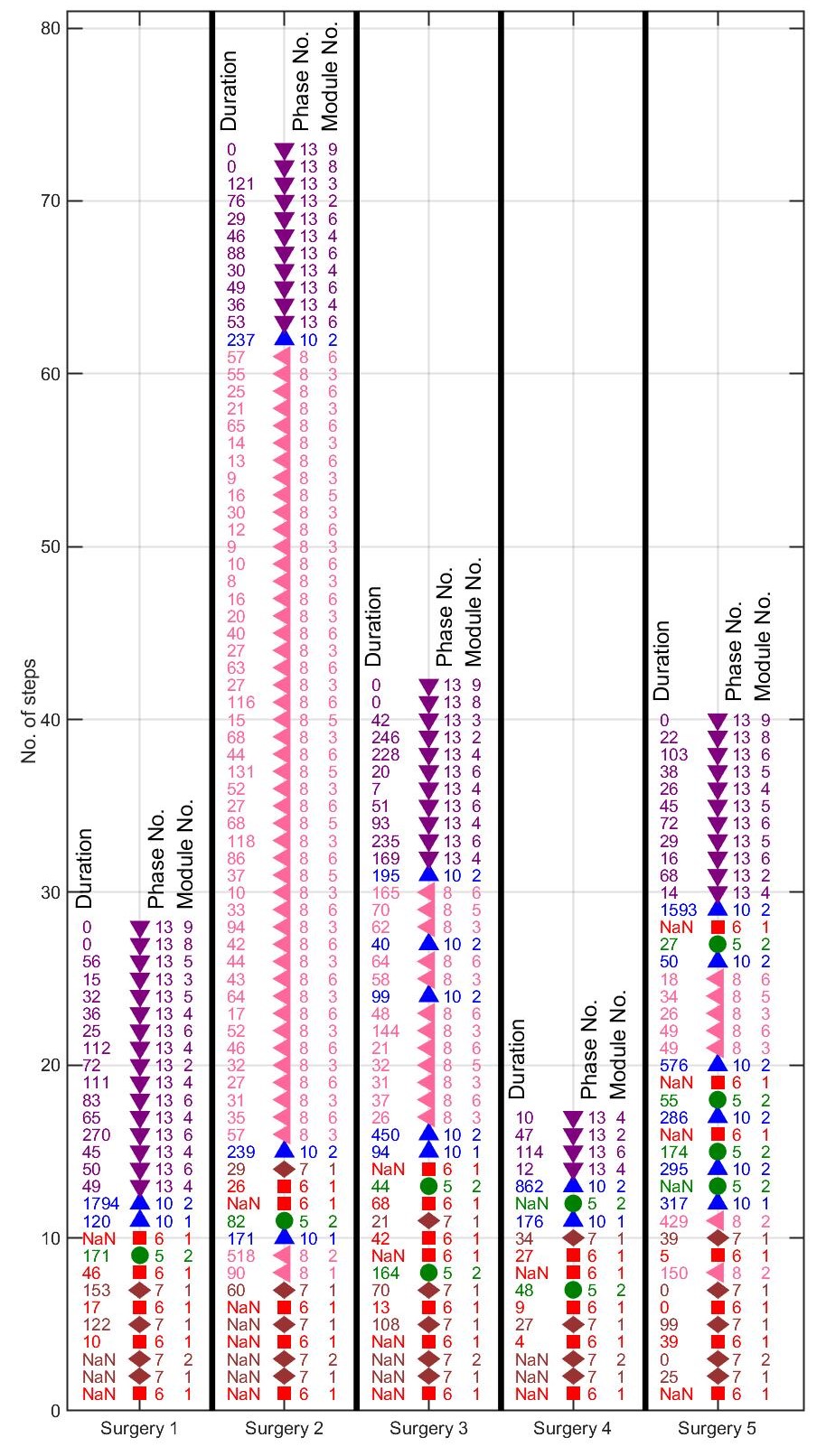
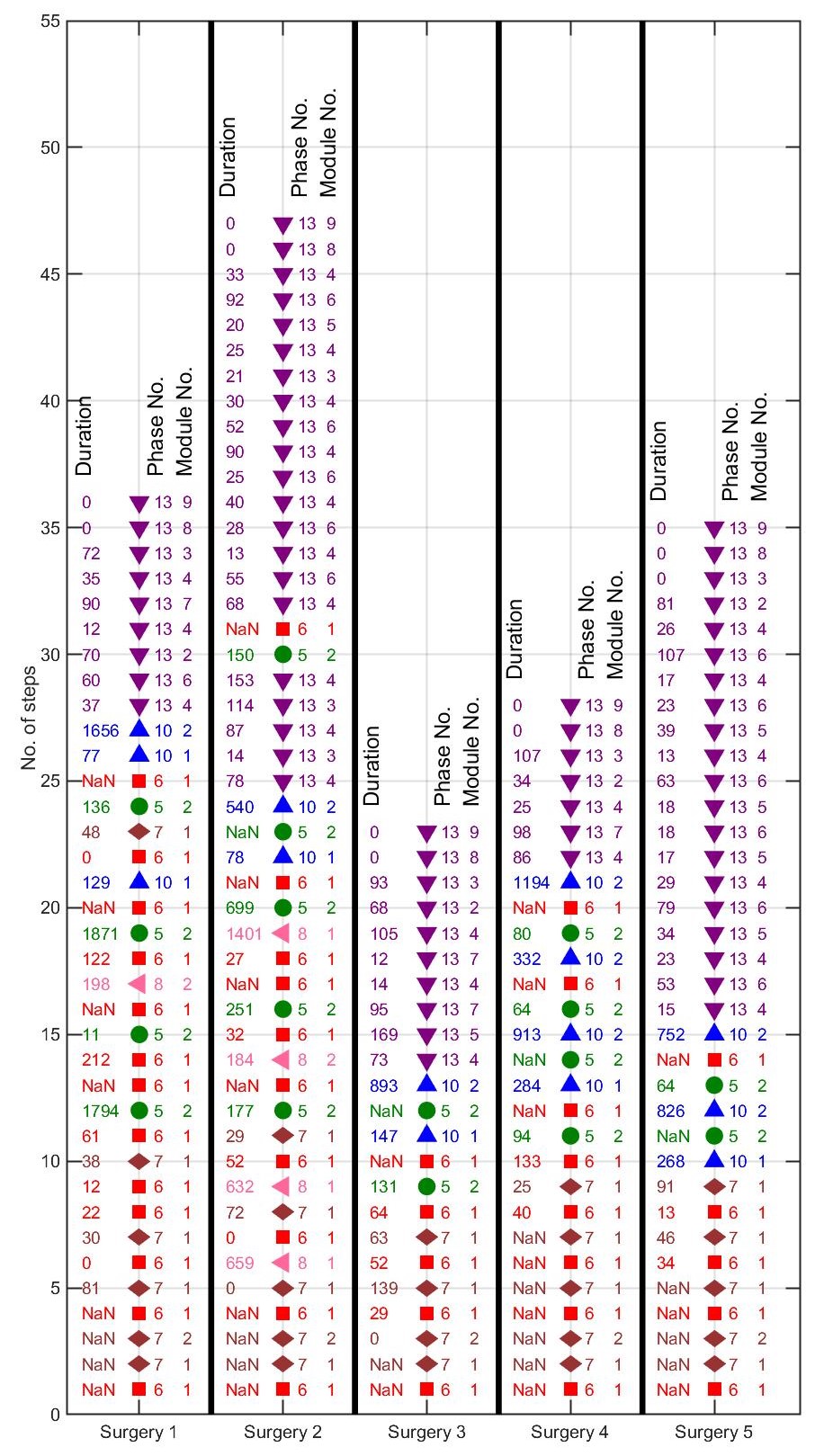
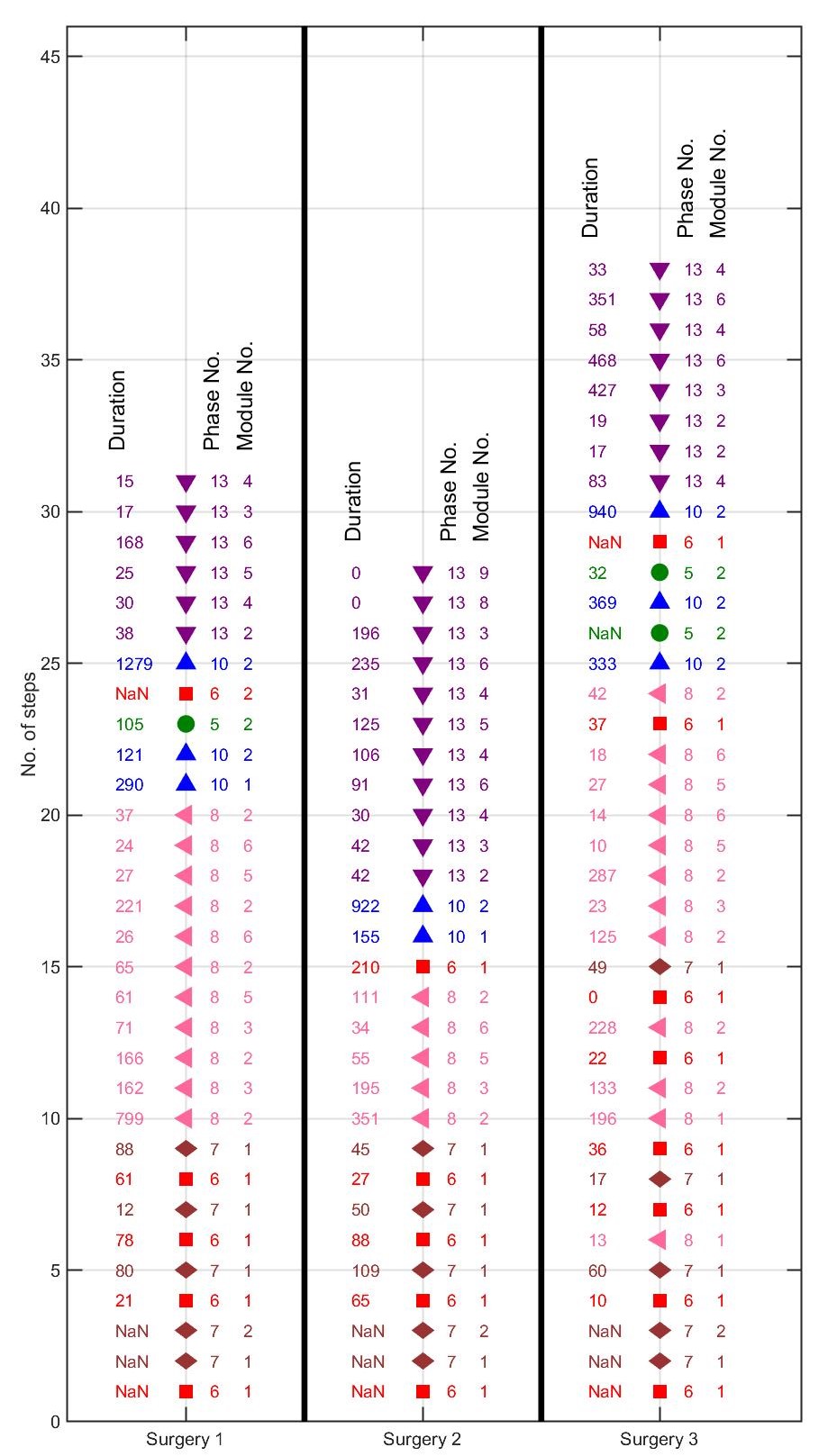
**

*Figure 1: The data for five endoscopic videos of laparoscopic liver resection of segments 5&6.*



*Figure 2: The data for five endoscopic videos of laparoscopic liver resection of segments 7&8.*

**

*Figure 3: The data for three endoscopic videos of laparoscopic liver resection of segments 5 with gallbladder removal.*

*Table 1: The raw data for five endoscopic videos of surgeries of segments 5&6, presented in Figure 1.*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Surgery 1 | | | Surgery 2 | | | Surgery 3 | | | Surgery 4 | | | Surgery 5 | | |
| **Phase** | **Module** | **Duration (s)** | **Phase** | **Module** | **Duration (s)** | **Phase** | **Module** | **Duration (s)** | **Phase** | **Module** | **Duration (s)** | **Phase** | **Module** | **Duration (s)** |
| 6 | 1 | NaN | 6 | 1 | NaN | 6 | 1 | NaN | 6 | 1 | NaN | 6 | 1 | NaN |
| 7 | 1 | 25 | 7 | 1 | NaN | 7 | 1 | NaN | 7 | 1 | NaN | 7 | 1 | NaN |
| 7 | 2 | 0 | 7 | 2 | NaN | 7 | 2 | NaN | 7 | 2 | NaN | 7 | 2 | NaN |
| 6 | 1 | 39 | 6 | 1 | 4 | 6 | 1 | NaN | 6 | 1 | NaN | 6 | 1 | 10 |
| 7 | 1 | 99 | 7 | 1 | 27 | 7 | 1 | 108 | 7 | 1 | NaN | 7 | 1 | 122 |
| 6 | 1 | 0 | 6 | 1 | 9 | 6 | 1 | 13 | 6 | 1 | NaN | 6 | 1 | 17 |
| 7 | 1 | 0 | 5 | 2 | 48 | 7 | 1 | 70 | 7 | 1 | 60 | 7 | 1 | 153 |
| 8 | 2 | 150 | 6 | 1 | 5 | 2 | 164 | 8 | 1 | 90 | 6 | 1 | 46 |
| 6 | 1 | 5 | 6 | 1 | 27 | 6 | 1 | 8 | 2 | 518 | 5 | 2 | 171 |
| 7 | 1 | 39 | 7 | 1 | 34 | 6 | 1 | 42 | 10 | 1 | 171 | 6 | 1 |
| 8 | 2 | 429 | 10 | 1 | 176 | 7 | 1 | 21 | 5 | 2 | 82 | 10 | 1 | 120 |
| 10 | 1 | 317 | 5 | 2 | 6 | 1 | 68 | 6 | 1 | 10 | 2 | 1794 |
| 5 | 2 | 10 | 2 | 862 | 5 | 2 | 44 | 6 | 1 | 26 | 13 | 4 | 49 |
| 10 | 2 | 295 | 13 | 4 | 12 | 6 | 1 | 7 | 1 | 29 | 13 | 6 | 50 |
| 5 | 2 | 174 | 13 | 6 | 114 | 10 | 1 | 94 | 10 | 2 | 239 | 13 | 4 | 45 |
| 6 | 1 | 13 | 2 | 47 | 10 | 2 | 450 | 8 | 3 | 57 | 13 | 6 | 270 |
| 10 | 2 | 286 | 13 | 4 | 10 | 8 | 3 | 26 | 8 | 6 | 35 | 13 | 4 | 65 |
| 5 | 2 | 55 |  |  |  | 8 | 6 | 37 | 8 | 3 | 31 | 13 | 6 | 83 |
| 6 | 1 |  |  |  | 8 | 3 | 31 | 8 | 6 | 27 | 13 | 4 | 111 |
| 10 | 2 | 576 |  |  |  | 8 | 5 | 32 | 8 | 3 | 32 | 13 | 2 | 72 |
| 8 | 3 | 49 |  |  |  | 8 | 6 | 21 | 8 | 6 | 46 | 13 | 4 | 112 |
| 8 | 6 | 49 |  |  |  | 8 | 3 | 144 | 8 | 3 | 52 | 13 | 6 | 25 |
| 8 | 3 | 26 |  |  |  | 8 | 6 | 48 | 8 | 6 | 17 | 13 | 4 | 36 |
| 8 | 5 | 34 |  |  |  | 10 | 2 | 99 | 8 | 3 | 64 | 13 | 5 | 32 |
| 8 | 6 | 18 |  |  |  | 8 | 3 | 58 | 8 | 6 | 43 | 13 | 3 | 15 |
| 10 | 2 | 50 |  |  |  | 8 | 6 | 64 | 8 | 3 | 44 | 13 | 5 | 56 |
| 5 | 2 | 27 |  |  |  | 10 | 2 | 40 | 8 | 6 | 42 | 13 | 8 | 0 |
| 6 | 1 |  |  |  | 8 | 3 | 62 | 8 | 3 | 94 | 13 | 9 | 0 |
| 10 | 2 | 1593 |  |  |  | 8 | 5 | 70 | 8 | 6 | 33 |  |  |  |
| 13 | 4 | 14 |  |  |  | 8 | 6 | 165 | 8 | 3 | 10 |  |  |  |
| 13 | 2 | 68 |  |  |  | 10 | 2 | 195 | 8 | 5 | 37 |  |  |  |
| 13 | 6 | 16 |  |  |  | 13 | 4 | 169 | 8 | 6 | 86 |  |  |  |
| 13 | 5 | 29 |  |  |  | 13 | 6 | 235 | 8 | 3 | 118 |  |  |  |
| 13 | 6 | 72 |  |  |  | 13 | 4 | 93 | 8 | 5 | 68 |  |  |  |
| 13 | 5 | 45 |  |  |  | 13 | 6 | 51 | 8 | 6 | 27 |  |  |  |
| 13 | 4 | 26 |  |  |  | 13 | 4 | 7 | 8 | 3 | 52 |  |  |  |
| 13 | 5 | 38 |  |  |  | 13 | 6 | 20 | 8 | 5 | 131 |  |  |  |
| 13 | 6 | 103 |  |  |  | 13 | 4 | 228 | 8 | 6 | 44 |  |  |  |
| 13 | 8 | 22 |  |  |  | 13 | 2 | 246 | 8 | 3 | 68 |  |  |  |
| 13 | 9 | 0 |  |  |  | 13 | 3 | 42 | 8 | 5 | 15 |  |  |  |
|  |  |  |  |  |  | 13 | 8 | 0 | 8 | 6 | 116 |  |  |  |
|  |  |  |  |  |  | 13 | 9 | 0 | 8 | 3 | 27 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 6 | 63 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 3 | 27 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 6 | 40 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 3 | 20 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 6 | 16 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 3 | 8 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 6 | 10 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 3 | 9 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 6 | 12 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 3 | 30 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 5 | 16 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 3 | 9 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 6 | 13 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 3 | 14 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 6 | 65 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 3 | 21 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 6 | 25 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 3 | 55 |  |  |  |
|  |  |  |  |  |  |  |  |  | 8 | 6 | 57 |  |  |  |
|  |  |  |  |  |  |  |  |  | 10 | 2 | 237 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 6 | 53 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 4 | 36 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 6 | 49 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 4 | 30 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 6 | 88 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 4 | 46 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 6 | 29 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 2 | 76 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 3 | 121 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 8 | 0 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 9 | 0 |  |  |  |

*Table 2: The raw data for five endoscopic videos of surgeries of segments 7&8, presented in Figure 2.*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Surgery 1 | | | Surgery 2 | | | Surgery 3 | | | Surgery 4 | | | Surgery 5 | | |
| Phase | Module | Duration (s) | Phase | Module | Duration (s) | Phase | Module | Duration (s) | Phase | Module | Duration (s) | Phase | Module | Duration (s) |
| 6 | 1 | NaN | 6 | 1 | NaN | 6 | 1 | NaN | 6 | 1 | NaN | 6 | 1 | NaN |
| 7 | 1 | NaN | 7 | 1 | NaN | 7 | 1 | NaN | 7 | 1 | NaN | 7 | 1 | NaN |
| 7 | 2 | NaN | 7 | 2 | NaN | 7 | 2 | 0 | 7 | 2 | NaN | 7 | 2 | NaN |
| 6 | 1 | NaN | 6 | 1 | NaN | 6 | 1 | 29 | 6 | 1 | NaN | 6 | 1 | NaN |
| 7 | 1 | NaN | 7 | 1 | NaN | 7 | 1 | 139 | 7 | 1 | 0 | 7 | 1 | 81 |
| 6 | 1 | 34 | 6 | 1 | NaN | 6 | 1 | 52 | 8 | 1 | 659 | 6 | 1 | 0 |
| 7 | 1 | 46 | 7 | 1 | NaN | 7 | 1 | 63 | 6 | 1 | 0 | 7 | 1 | 30 |
| 6 | 1 | 13 | 6 | 1 | 40 | 6 | 1 | 64 | 7 | 1 | 72 | 6 | 1 | 22 |
| 7 | 1 | 91 | 7 | 1 | 25 | 5 | 2 | 131 | 8 | 1 | 632 | 6 | 1 | 12 |
| 10 | 1 | 268 | 6 | 1 | 133 | 6 | 1 | 6 | 1 | 52 | 7 | 1 | 38 |
| 5 | 2 | 5 | 2 | 94 | 10 | 1 | 147 | 7 | 1 | 29 | 6 | 1 | 61 |
| 10 | 2 | 826 | 6 | 1 | 5 | 2 | 5 | 2 | 177 | 5 | 2 | 1794 |
| 5 | 2 | 64 | 10 | 1 | 284 | 10 | 2 | 893 | 6 | 1 | 6 | 1 |
| 6 | 1 | 5 | 2 | 13 | 4 | 73 | 8 | 2 | 184 | 6 | 1 | 212 |
| 10 | 2 | 752 | 10 | 2 | 913 | 13 | 5 | 169 | 6 | 1 | 32 | 5 | 2 | 11 |
| 13 | 4 | 15 | 5 | 2 | 64 | 13 | 7 | 95 | 5 | 2 | 251 | 6 | 1 |
| 13 | 6 | 53 | 6 | 1 | 13 | 4 | 14 | 6 | 1 | 8 | 2 | 198 |
| 13 | 4 | 23 | 10 | 2 | 332 | 13 | 7 | 12 | 6 | 1 | 27 | 6 | 1 | 122 |
| 13 | 5 | 34 | 5 | 2 | 80 | 13 | 4 | 105 | 8 | 1 | 1401 | 5 | 2 | 1871 |
| 13 | 6 | 79 | 6 | 1 | 13 | 2 | 68 | 5 | 2 | 699 | 6 | 1 |
| 13 | 4 | 29 | 10 | 2 | 1194 | 13 | 3 | 93 | 6 | 1 | 10 | 1 | 129 |
| 13 | 5 | 17 | 13 | 4 | 86 | 13 | 8 | 0 | 10 | 1 | 78 | 6 | 1 | 0 |
| 13 | 6 | 18 | 13 | 7 | 98 | 13 | 9 | 0 | 5 | 2 | 7 | 1 | 48 |
| 13 | 5 | 18 | 13 | 4 | 25 |  |  |  | 10 | 2 | 540 | 5 | 2 | 136 |
| 13 | 6 | 63 | 13 | 2 | 34 |  |  |  | 13 | 4 | 78 | 6 | 1 |
| 13 | 4 | 13 | 13 | 3 | 107 |  |  |  | 13 | 3 | 14 | 10 | 1 | 77 |
| 13 | 5 | 39 | 13 | 8 | 0 |  |  |  | 13 | 4 | 87 | 10 | 2 | 1656 |
| 13 | 6 | 23 | 13 | 9 | 0 |  |  |  | 13 | 3 | 114 | 13 | 4 | 37 |
| 13 | 4 | 17 |  |  |  |  |  |  | 13 | 4 | 153 | 13 | 6 | 60 |
| 13 | 6 | 107 |  |  |  |  |  |  | 5 | 2 | 150 | 13 | 2 | 70 |
| 13 | 4 | 26 |  |  |  |  |  |  | 6 | 1 | 13 | 4 | 12 |
| 13 | 2 | 81 |  |  |  |  |  |  | 13 | 4 | 68 | 13 | 7 | 90 |
| 13 | 3 | 0 |  |  |  |  |  |  | 13 | 6 | 55 | 13 | 4 | 35 |
| 13 | 8 | 0 |  |  |  |  |  |  | 13 | 4 | 13 | 13 | 3 | 72 |
| 13 | 9 | 0 |  |  |  |  |  |  | 13 | 6 | 28 | 13 | 8 | 0 |
|  |  |  |  |  |  |  |  |  | 13 | 4 | 40 | 13 | 9 | 0 |
|  |  |  |  |  |  |  |  |  | 13 | 6 | 25 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 4 | 90 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 6 | 52 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 4 | 30 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 3 | 21 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 4 | 25 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 5 | 20 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 6 | 92 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 4 | 33 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 8 | 0 |  |  |  |
|  |  |  |  |  |  |  |  |  | 13 | 9 | 0 |  |  |  |

*Table 3: The raw data for three endoscopic videos of surgeries of segments 5 with gallbladder removal, presented in Figure 3.*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Surgery 1 | | | Surgery 2 | | | Surgery 3 | | |
| Phase | Module | Duration (s) | Phase | Module | Duration (s) | Phase | Module | Duration (s) |
| 6 | 1 | NaN | 6 | 1 | NaN | 6 | 1 | NaN |
| 7 | 1 | NaN | 7 | 1 | NaN | 7 | 1 | NaN |
| 7 | 2 | NaN | 7 | 2 | NaN | 7 | 2 | NaN |
| 6 | 1 | 10 | 6 | 1 | 65 | 6 | 1 | 21 |
| 7 | 1 | 60 | 7 | 1 | 109 | 7 | 1 | 80 |
| 8 | 1 | 13 | 6 | 1 | 88 | 6 | 1 | 78 |
| 6 | 1 | 12 | 7 | 1 | 50 | 7 | 1 | 12 |
| 7 | 1 | 17 | 6 | 1 | 27 | 6 | 1 | 61 |
| 6 | 1 | 36 | 7 | 1 | 45 | 7 | 1 | 88 |
| 8 | 1 | 196 | 8 | 2 | 351 | 8 | 2 | 799 |
| 8 | 2 | 133 | 8 | 3 | 195 | 8 | 3 | 162 |
| 6 | 1 | 22 | 8 | 5 | 55 | 8 | 2 | 166 |
| 8 | 2 | 228 | 8 | 6 | 34 | 8 | 3 | 71 |
| 6 | 1 | 0 | 8 | 2 | 111 | 8 | 5 | 61 |
| 7 | 1 | 49 | 6 | 1 | 210 | 8 | 2 | 65 |
| 8 | 2 | 125 | 10 | 1 | 155 | 8 | 6 | 26 |
| 8 | 3 | 23 | 10 | 2 | 922 | 8 | 2 | 221 |
| 8 | 2 | 287 | 13 | 2 | 42 | 8 | 5 | 27 |
| 8 | 5 | 10 | 13 | 3 | 42 | 8 | 6 | 24 |
| 8 | 6 | 14 | 13 | 4 | 30 | 8 | 2 | 37 |
| 8 | 5 | 27 | 13 | 6 | 91 | 10 | 1 | 290 |
| 8 | 6 | 18 | 13 | 4 | 106 | 10 | 2 | 121 |
| 6 | 1 | 37 | 13 | 5 | 125 | 5  6 | 2  1 | 105 |
| 8 | 2 | 42 | 13 | 4 | 31 |
| 10  5 | 1  2 | 333 | 13 | 6 | 235 | 10 | 2 | 1279 |
| 13 | 3 | 196 | 13 | 2 | 38 |
| 10 | 2 | 369 | 13 | 8 | 0 | 13 | 4 | 30 |
| 5  6 | 2  1 | 32 | 13 | 9 | 0 | 13 | 5 | 25 |
|  |  |  | 13 | 6 | 168 |
| 10 | 2 | 940 |  |  |  | 13 | 3 | 17 |
| 13 | 4 | 83 |  |  |  | 13 | 4 | 15 |
| 13 | 2 | 17 |  |  |  |  |  |  |
| 13 | 2 | 19 |  |  |  |  |  |  |
| 13 | 3 | 427 |  |  |  |  |  |  |
| 13 | 6 | 468 |  |  |  |  |  |  |
| 13 | 4 | 58 |  |  |  |  |  |  |
| 13 | 6 | 351 |  |  |  |  |  |  |
| 13 | 4 | 33 |  |  |  |  |  |  |