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Wound healing after cervical spine surgery.

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Abstract.
Background.
Optimal management of surgical wounds is an important part of post-operative recovery and health care professionals should monitor the process of acute wound healing, prevent wound complications and treat appropriately if complications arise. The key elements of post-operative wound management include timely review of the wound, appropriate cleansing and dressing, and early recognition and intervention of wound complications.
The aim of thi study was to assess the quality of wound healing after cervical spine surgery.
Material and methods.
The study involved 645 patients operated on at the Department of Neurosurgery of St Luke Hospital, Tarnów in 2007 - 2013. The study group included 272 women and 373 men aged between 7 and 90 years. Mean age was 49,2 years in the entire study population. The group with wound complications consisted of 46 patients (7%). Postoperative wound status was assessed daily during the patients stay in the hospital. The sutures were removed after 7 days in patients with normal wound healing.
Results and conclusion.
A lower percentage of complications was registered in patients under 65 years of age.
In patients operated on from the anterior approach recorded a significantly lower percentage of postoperative wound complications.
Using an orthopedic collar increases the risk of complications.
A higher percentage of complication was registered in patients with rheumatoid arthritis.
The highest risk of wound complications occurred in patients after 4-level operations.
Patients treated with posterior approach using implants are most at risk of wound complications.
Key words*: wound, healing, cervical spine, surgery*

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I. Background.

Surgical strategies include decompression of neural elements and stabilization when necessary, either through an anterior, posterior or combined approach. The approach selection is influenced by the location of the compressive element, type of fracture or ligament injury and the overall alignment. Surgeons need to be aware of possible complications with each step of the procedure and the methods to avoid or manage them [1].

The aims of post-operative wound care remain to allow the wound to heal rapidly without complications, and with the best functional and aesthetic results [2,3]. Wounds intended to be healed by primary healing should, in particular, have their wound edges well approximated. In the initial phases of healing, there is only minimal tensile strength in the wound as remodelling of the collagen fibres has not occurred. As such, additional support in the form of sutures, staples or tapes is required until full remodelling and epithelialisation occur [2].

Optimal management of surgical wounds is an important part of post-operative recovery and health care professionals should monitor the process of acute wound healing, prevent wound complications and treat appropriately if complications arise. The key elements of post-operative wound management include timely review of the wound, appropriate cleansing and dressing, and early recognition and intervention of wound complications [2].

Among the most common postoperative complications associated with readmissions are wound complications, including surgical site infections (SSIs) and wound dehiscence and haematomas [4, 5, 6]. Similar

to SSIs, wound dehiscence is, a costly complication reported as the second most common postoperative complication in spinal fusion procedures with negative impact on patients recovery [4, 7, 8, 9].

Wound complications represent, a significant risk factor in spinal sugery, particularly in complex multilevel procedures. Surgical site infections (SSI) are the most common health care– associated infection, accounting for 31% of all hospitalized patients with a health care–associated infection [8, 10].

The aim of thi study was to assess the quality of wound healing after cervical spine surgery.

II. Material And Methods.

The study involved 645 patients operated on at the Department of Neurosurgery of St Luke Hospital, Tarnów in 2007 - 2013. The study group included 272 women and 373 men aged between 7 and 90 years. Mean age was 49,2 years in the entire study population, 50,9 years for women and 48,1 years for men. The group with wound complications consisted of 46 patients (7%). The subjects were 17 women and 29 men aged 7–88 years. Mean age was 54,4 years.

Postoperative wound status was assessed daily during the patients stay in the hospital. The sutures were removed after 7 days in patients with normal wound healing. The analysis included the following factors that may affect healing: patient age, operative access, type of surgery, use and type of orthopedic collar, rheumatoid arthritis (RA).

Institutional Ethical Committee Acceptance: wound evaluation is a routine procedure for monitoring the wound healing process. No ethical committee acceptance was required.

A description of the study group data was prepared based on the number and proportion of each experimental variant. The analysis used a chi-square χ^2 test of independence. A p value of less than 0.05 was considered statistically significant.

III. Results

There were no statistically significant differences between postoperative wound healing and patient sex. The significance level of the $\chi 2$ test was $p = 0.4728$. However, the presence of statistically significant differences in wound healing was observed depending on: the age of patients, surgical approach, the use of an orthopedic collar and the presence of rheumatoid arthritis. A higher percentage of difficulties in healing postoerative wound was recorded in the group over 65 years 17.5%, with 6.5% in patients under 65 years. A higher percentage of complications was confirmed in patients treated with posterior approach 38% than in anterior approach 0.75%. The proportion of patients with difficulty in wound healing was 12.5% in the group treated with a collar and 2.5% in patients treated without. The analysis showed that the type of collar has no effect on wound healing. A higher percentage of postoperative wound healing difficulties was recorded in the group of patients with rheumatoid arthritis 44% compared to the remaining group of patients 6% (table 1).

Table 1. Difficulties with wound healing depending on: age, surgical approach, wearing orthopedic collar, rheumatoid arthritis.

Along with the increase in the number of operated segments, the percentage of patients who have difficulties in healing the postoperative wound increases. The lowest rate of complications was observed at 1 level surgery 4.5%, the highest after 4 levels 31%. The observed differences were statistically significant (table 2).

Table 2. Difficulties in wound healing depending on the number of operated segments.

The presence of statistically significant differences in wound healing was observed depending on the type of surgery. The highest number of complications occurred in the treated group from the posterior approach with implants: 41% and without implants 30%. The lowest number of difficulties with wound healing was confirmed in patients after 1% dysctectomy / corpectomy (table 3).

Table 3. Difficulties with wound healing depending on the type of surgery.

IV. Discussion.

The reported incidence of SSIs following spine surgery ranges from 0.2% to 18.8% [8, 11, 12]. The risk of wound complication in our study was 7%. Piper et. al. [4] writes that wound complication rates of 0.2–4.2% following spine surgery. Of the 99,152 patients included in this study, 2.2% experienced at least one wound complication (superficial SSI: 0.9%, deep SSI: 0.8%, organ space SSI: 0.4%, and dehiscence: 0.3%) [4]. The development of postoperative haematoma at the wound site is a relatively less frequent complication with

incidence varying between 1% and 11%. Meticulous haemostasis and avoidance of prolonged soft tissue retraction possibly help reducing its incidence [13, 14, 15].

The risk of wound complication in our study after anterior cervical discectomy and fusion (ACDF) in our study was 0,75%. Postoperative infection after ACDF is exceedingly uncommon. Reports of postoperative infection in the anterior cervical spine range from 0.05% to 1.6% [16]. Yadav et. al. [13] writes that one patient (0.78%) developed a wound infection at the operative site after anterior cervical discectomy and fusion. The incidence of postoperative wound infections in ACDF is 0.1%–1.6%. Postoperative infection usually presents as pain, local erythema and wound drainage [1, 15]. Hemmer [16] reports that risk of infections and postoperative hematoma after anterior approach is very uncommon while after posterior approach slightly more common.

The risk of wound complications in patients with 3 level spine fusion was 11% and with 4 level spine 31% in our study. Yilmaz et.al. Writes that the risk of wound complications in patients with 3 level posterior spine fusion ranges from 1.5% to 3.7% [8]. Operations longer than 3 hours increase the risk of infection. Good surgical technique is fundamental for reducing infection. This includes meticulous dissection within avascular planes, potential dead spaces, intermittent release of retractors, careful haemostasis with frequent irrigation and closure of potential dead spaces. Local application of vancomycin powder is also useful in reducing surgical site infections, especially in long posterior fusions [8].

Spine surgery has a higher incidence of surgical site infection (SSI) than surgeries on other parts of the skeleton. Increasing sophistication of spinal instrumentation and developments in anaesthesia have allowed surgical intervention in increasingly complex spinal pathologies. This, in turn, has increased the SSI risk. According to the abundant literature, the SSI incidence in spinal surgery varies considerably from 0.7% to 25%, although most of the reported rates lie between 2% and 5%. In conclusion, the incidence of surgical site infection in SSI was significantly lower in patients who received a 72 h microbial antibiotic prophylaxis regimen compared with those treated with a single-dose regimen. Analysing individual categories of data suggested that 72 h prophylaxis was the most important factor for minimizing the risk of wound infection in study group [17].

Multivariate binary logistic regression testing found 10 preoperative characteristics associated with wound complications: body mass index ≥30, smoker, female, chronic steroid use, hematocrit <38%, infected wound, American Society of Anesthesiologists ASA class ≥ 3, inpatient procedure, emergency case, and operation time >3 hours. Patients with unweighted risk scores >7 were 25 fold more likely to develop, a wound complication compared to patients with scores of 0. In addition, mortality rate, reoperation rate, and total length of stay each increased nearly 10 fold with increasing risk score [4].

Certain patient factors may increase the risk of post-operative wound complications. These include the type of surgery and the body part involved, certain medications, immunosuppressive disorders, poorly controlled diabetes, peripheral vascular disease, tobacco smoking and malnutrition [2, 18, 19, 20]. Immunosuppresive agents, such as prednisolone and methotrexate, and immunosuppressive disorders suppress the inflammatory process and delay wound healing [2].

V. Conclusion

1 A lower percentage of complications was registered in patients under 65 years of age.
2 In patients operated on from the anterior approach recorded a significantly lower percentage of postoperative wound complications.
3 Using an orthopedic collar increases the risk of complications.
4 A higher percentage of complication was registered in patients with rheumatoid arthritis.
5 The highest risk of wound complications occurred in patients after 4-level operations.
6 Patients treated with posterior approach using implants are most at risk of wound complications.

Conflicts of interest: all authors declare no conflict of interest.

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Table 1. Difficulties with wound healing depending on: age, surgical approach, wearing orthopedic collar, rheumatoid arthritis.

	Difficulties No	**Difficulties Yes**	χ^2
< 65 years	479 (93,5%)	33 (6,5%)	p<0,001
> 65 years	61 (82,5%)	13 (17,5%)	
anterior access	530 (99,25%)	4 (0,75%)	p<0,0001
posterior access	64 (62%)	39 (38%)	
orthopedic collar yes	333 (97,65%)	8 (2,5%)	p<0,0001
orthopedic collar no	266 (87,5%)	38 (12,5%)	
rheumatoid arthritis	14 (56%)	11 (44%)	p<0,0001
without rheumatoid arthritis	585 (94%)	35 (6%)	

Table 2. Difficulties in wound healing depending on the number of operated segments.

Number of operated segments	**Difficulties No**	**Difficulties Yes**	χ^2
1	345 (95,5%)	16 (4,5%)	p<0,0001
2	177 (94,5%)	10 (5,5%)	
3	40 (89%)	5 (11%)	
4	33 (69%)	15 (31%)	

Table 3. Difficulties with wound healing depending on the type of surgery.

	Difficulties No	**Difficulties Yes**	χ^2
dysctectomy / corpectomy	469 (99%)	4 (1%)	p<0,0001
anterior odontoid screw	57 (98%)	1 (2%)	
posterior approach without implants	32 (70%)	14 (30%)	
posterior approach with implants	34 (59%)	24 (41%)	

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