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Summary
In the introduction (chapter 1) a brief history of the neck dissection, in head and neck oncology treatment, is described based on the manuscript of Crile in 1906. About 50 years later, in 1952, Ewing described the postoperative morbidity after radical neck dissection: shoulder complaints, pain, disfigurement, loss of sensation, functional loss, restricted daily activities, and loss of strength. The reported prevalence of shoulder complaints after radical neck dissections are high (47% to 100%). Because of these postoperative morbidity and the gained insight in the biological behaviour of head and neck tumours modified and selective neck dissections were developed. The most important modification was preservation of the spinal accessory nerve. Prevalence rates of shoulder complaints after modified radical neck dissections (18 % to 61 %) and after selective neck dissections (29 % to 39 %) seem to decrease.

The occurrence of shoulder complaints is strongly related to spinal accessory dysfunction. The spinal accessory nerve normally innervates the trapezius muscle, if this connection is disintegrated atrophy of the trapezius muscle will be the consequence. As a result of this the scapula, which is normally stabilised on the thorax by the trapezius muscle, will glide laterally and the glenoid fossa will point more caudally. A restricted range of motion of the shoulder and loss of function will be the consequence. Pain may occur as a consequence of this, although it is still scarcely described what causes pain.

The occurrence of shoulder complaints after modified or selective procedures with preservation of the spinal accessory nerve seems less well understood.

Aim of this thesis was to obtain a better understanding about physical complaints (shoulder complaints, pain, range of motion, loss of sensation) function (activities of daily life, shoulder function), psychological factors (depression), and quality of life after head and neck cancer treatment.

In chapter 2 the pilot study is described. The purpose of that pilot study was to assess shoulder morbidity; pain and disability in daily activities one year after unilateral or bilateral supraomohyoid neck dissection. In total 52 patients were included. These patients filled out a questionnaire assessing pain and daily activities. Of these patients 14 (28%) complained of ipsilateral shoulder pain following supraomohyoid neck dissection. The
disability, because of shoulder complaints, perceived during daily life was minor. In only two patients the pain and disability led to dependency of others for heavy household activities. It was concluded that despite the fact that the supraomohyoid neck dissection was also developed to reduce shoulder morbidity, 28% of the patients experience some type of shoulder pain following supraomohyoid neck dissection. The degree of disability due to shoulder complaints was minor.

In chapter 3 the incidence of shoulder pain and reduced range of motion of the shoulder after neck dissection in the clinical period was studied. Additionally risk factors for the development of shoulder pain and a restricted shoulder range of motion were identified. Clinical patients who underwent a neck dissection completed a questionnaire assessing shoulder pain the day before discharge from the hospital. Range of motion of the shoulder was measured, abduction and forward flexion. Information about surgery and type of neck dissection was retrieved from the medical records. Of the 177 patients included 70% experienced shoulder pain, which mainly occurred during moving the shoulder (31%), and lying on the affected shoulder (30%). Forward flexion and abduction of the operated side was severely reduced compared to the non-operated side. Non-selective neck dissection was a risk factor for the development of shoulder pain and a restricted shoulder abduction. Reconstruction after tumour resection was a risk factor for a restricted forward flexion of the shoulder.

In chapter 4 the prevalence of shoulder complaints after nerve sparing neck dissection with or without radiation therapy at least one year after surgery is described. Patients were interviewed for shoulder complaints, and filled out the shoulder disability questionnaire to evaluate shoulder disability in daily activities. In total 137 patients; 51 after modified radical neck dissection (MRND), 21 after postero-lateral neck dissection (PLND), and 65 after supraomohyoid neck dissection (SOHND) were analysed. After MRND 33.3% of the patients experienced shoulder complaints, after PLND 66.7 %, and after SOHND 20 % of the patients experienced shoulder complaints. Type of neck dissection was significantly (p < 0.001) related to shoulder complaints. Radiation therapy was not significantly related to shoulder complaints and disability. Outcome on the shoulder disability questionnaire
also showed a significant (p< 0.01) difference in outcome for type of neck dissection. Age and follow up were not of significant influence on shoulder complaints.

It was concluded that a SOHND prevents for shoulder complaints and that disability in daily activities are the lowest after SOHND.

In chapter 5 the relationship between shoulder morbidity (pain and range of motion), and the spinal accessory nerve function after neck dissection was analysed. Spinal accessory nerve dysfunction was made operational by three clinical signs: atrophy of the trapezius muscle, shoulder drop and an objectified changed scapula posture. If two out of three signs were present a spinal accessory nerve dysfunction was assumed. Shoulder pain was measured with a numbered VAS over the last week. Shoulder abduction was assessed, and a difference of ≥ 40° compared to the non-operated side was assumed to be clinical relevant.

In total 112 patients after neck dissection (73 male/ 39 female) were included. Of this group 39 patients complained of shoulder pain. Of the patients with shoulder complaints 20 (51%) had dysfunction of the spinal accessory nerve. Of the total 29 group of patients (26%) had dysfunction of the spinal accessory nerve of whom 20 (69%) had shoulder pain. Shoulder pain and a difference in active shoulder abduction of ≥ 40° are significantly related to dysfunction of the spinal accessory nerve (p <0.001). Shoulder pain after neck dissection can only be attributed in 50% of the patients to dysfunction of the spinal accessory nerve.

In chapter 6 the consequences of head and neck cancer therapy on the neck itself are described. Patients who underwent surgery, including neck dissection, with or without radiation therapy, at least one year before the study, were asked to participate. Neck pain, loss of sensation, range of motion of the cervical spine, and shoulder pain was assessed.

Of the 220 patients who were invited 153 (70 %) participated in the study. Neck pain was present in 33% (n=51) of the patients, and shoulder pain in 37% (n=57). Neck pain and shoulder pain were significantly related (p <0.001). Of the patients who experienced neck pain 20 (39 %) had allodynia in the neck, and 49 (96%) experienced hyperpathia, the mean VAS intensity
of neck pain was 3.5 (sd 2.3). Of the study group 32% (n=49) experienced neuropathic pain, 46% (n=70) experienced myofascial pain, and 24% (n=37) experienced joint pain. Loss of sensation of the neck was present in 65% (n=99) and was related to type of neck dissection and radiation therapy. Range of motion of the neck was significantly decreased, in lateral flexion away from the operated side, due to the neck dissection and or radiation therapy. Morbidity of the neck after cancer therapy occurred frequently.

In chapter 7 the impact of neck and shoulder complaints on quality of life are described. Quality of life has become a major outcome in determining treatment effects in head and neck surgery with curative intent, as well as many other medical domains. Aim of this study was to determine which factors were related to quality of life, and how these outcomes where related to a at randomly chosen control group. As outcome measurement the RAND-36 (SF-36) was assessed. The following items were entered as independent variables into the linear regression: age, follow-up, gender (male/female), education (no education, elementary school/higher education), social support (living alone/married, living with somebody else), employment (working, house wife, volunteer / no employment), depression (CES-D), Visual Analog Scale (0-10) for pain in the head, neck both sides, shoulders and arms, range of motion of the neck and shoulders, and sensibility (number of area’s, 0-6).

Depression scores contributed significantly to all domains of quality of life. Reduced shoulder abduction, shoulder pain, and neck pain were related to several domains of quality of life. The patient group scored significantly worse for social functioning and limitations due to physical problems, but scored significantly better for bodily pain and health changes than the control group.

It was concluded that head and neck cancer patients score relatively good on quality of life. Depression has the strongest relationship with several domains but also physical complaints are significantly related to several domains.

In chapter 8 a study is described in which the validity of measuring somatic items in a depression questionnaire in patients after cancer treatment is described. Several authors describe that measuring somatic items in patients
after cancer treatment is not valid because the somatic problems assessed in a questionnaire are strongly related to the somatic morbidity caused by the cancer treatment. These authors propose to remove the somatic items in a depression questionnaire when assessing cancer patients. In total 206 patients with breast cancer, 136 patients with colo-rectal cancer, 69 with gynaecological cancer, and 155 with head and neck cancer were assessed. As a control group 255 patients randomly chosen Dutch people were assessed matched for age and gender out of the same region as the cancer patients. All patients were about 15 months after treatment. Cancer patients do score higher on the somatic domain compared to the control group. But cancer patients were not a homogenous group with respect to somatic morbidity. Colo-rectal patients score much lower than the control group while head and neck and breast cancer patients score significantly higher than the control group. Gender (female) has an important influence in all domains. It seems not valid to remove somatic items from the CES-D for measuring cancer patients.

**General discussion** head and neck cancer treatment leads to considerable morbidity; physically, emotionally, and socially. In this thesis the incidences of shoulder complaints after radical, modified and selective neck dissections that occur after head and neck cancer treatment are described. The clinical implications are that through this study a better understanding in the diversity of complaints in patients after head and neck treatment was achieved. This knowledge can be implemented in care of surgeons, physical therapists, nurses, and psychologists.

How can patients, after head and neck cancer therapy, benefit from the results of this thesis. Together with the Dutch Physical Therapy Neck Dissection Study Group (Nederlandse Fysiotherapie Halsklierdissectie Studie Groep, NFHSG), physical therapy guidelines for patients after neck dissection were developed (appendix 1). The guidelines include diagnostic criteria, information for colleagues, an exercise program for shoulder problems after neck dissection, treatment advises and a research protocol to assess patients prospectively. In the clinical assessment of patients after neck dissection currently patients are asked to shrug their shoulders to assess trapezius muscle dysfunction. From

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our study it became clear that for a quick assessment of trapezius muscle function the patient should be asked for to abduct both arms on the same time, and look for differences in range of motion. When differences are found or when patients report shoulder pain an inspection of the shoulder region is of importance to assess the trapezius muscle and to investigate the type of pain. Furthermore psychological problems, especially depression, are of importance to assess in the post-clinical phase because of its influence on quality of life. Pain is one of the most important forms of morbidity. A distinction should be made in nociceptive, neuropathic, and myofascial pain. However in all types of pain the influence of psychological or social problems must be considered.